NATURE

No. 3801 SATURDAY, SEPT. 5, 1942 Vol. 150

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Editorial and Publishing Offices
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2
Telephone Number : Whitehall 8831
Telegrams : Phusis Lesquare London

Advertisements should be addressed to
T. G. Scott & Son, Ltd., Talbot House, 9, Arundel Street, London, W.C.2
Telephone : Temple Bar 1942-3

The annual subscription rate is £4 10 0, payable in advance, Inland or Abroad

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PRESERVATION OF OXFORD

WHILE it is recognized that without some measure of central direction and regional guidance there can be no re-planning and reconstruction of our towns or countryside which will ensure the best use of the nation's reserves of land, the right balance between industry and agriculture, between work and leisure, that is, the best from the point of view of social and cultural as well as material needs, it is in the application of the planning principles and policy to particular local problems that the individual citizen is most interested. Those are the consequences that are likely to provoke his most speedy reaction, and his support of, or opposition to, any Ministry of Planning. He will judge of its value by the results that he can see in the district most familiar to him.

On that ground the report of the Committee on Planning and Reconstruction appointed in November 1940 by the Oxford Preservation Trust is indeed of more than local interest. The second part of the report which has now been issued (see page 297) deals with questions directly related to the old University City of Oxford, and includes a summary of the conclusions presented in April 1941 in the first part of the report, which was concerned with planning for the Oxford region and how far the measures that are necessary locally are dependent on national action. But the national interest of the second part of the report is actually scarcely less than that of the first part, in spite of its narrow scope, and the announcement of the endowment of a chair of social medicine at Oxford by the Nuffield Trust gives a sufficient clue to the fundamental reason.

The report gives a good historical sketch of the changes in Oxford in the last generation and of the acute problems which continued development presents. The evils described still remain and may be greatly intensified in the future. Indeed, the unique character of the Universities of Oxford and Cambridge is something worth cherishing and worth defending as a national rather than as a local inheritance only. It would be a national disaster and no mere local tragedy if we allowed rapid and uncontrolled industrial development to thwart either the growth of the university in such directions as Nuffield College has stimulated or the remoulding of the City of Oxford itself and its preservation from the sordid encroachments that have been allowed to sully it.

No city, in fact, has a greater duty and a greater opportunity than Oxford to take a leading part in the movement to remould social conditions and to add fresh splendours of architecture, new beauties of park and garden and spacious emplacement to our heritage. The study that has already been given to the physical planning of town and country has eased the way, and the times are favourable, not only for taking further preventive measures to safeguard the University and City from further detriment, but also to remedy, so far as practicable, the injuries already suffered, as well as to adopt a broad constructive policy for the future. The report outlines

a complete scheme for the preservation and ordered development of Oxford, undeterred by doubts as to its financial feasibility. It recognizes the need for careful consideration of existing interests—that a city is not a mere collection of buildings with services of roads, light, water and the rest. With its emphasis on the community and its individual and social needs, it advances a plan bold and comprehensive enough to command wide approval.

The report points out that it is almost impossible to forecast what may be the extent and nature of future developments in the University, and it is of the utmost importance therefore that a generous view should be taken of the need there may be for expansion on the part of the University and the colleges. Through lack of foresight and collaboration, they have made not a few mistakes in the past, and the University can already provide examples of the consequences of defective planning. Moreover, the tendency noted in recent years for research institutes to seek establishment in Oxford may develop very greatly after the War; and should the number of university students even equal that at Cambridge, much fresh building would be required for their accommodation. It is doubtful whether it has been sufficiently considered how many new sites of liberal extent may be required if, after the War, Oxford were to prove, as it well might, a far more powerful magnet for the attraction of specialists and students from all over the world than it has in the past.

The splendid new facilities for bringing research into contact with the problems of medicine and of social and economic organization made possible by Lord Nuffield's benefactions are a pointer in this direction which should not be overlooked any more than their implications for civic development. The University of Oxford is no longer an institution catering for only one section of the nation. At least half its students are drawn from the less wealthy classes of the community. Its teaching and research embrace the social sciences, and members of the University have proved themselves as leaders in many departments of the national life. Moreover, just as the welfare and environment of the University is not a matter of merely local concern, so the embellishment of the City of Oxford with a civic centre and other developments recommended in the report to rescue it from its present disfigurements, and with the new features that are proposed, and adequate hotel accommodation, should lead to an even greater number of visitors to Oxford, with much financial benefit to the catering and other trades of the city. Its proximity to Stratford-on-Avon would help to make the district one of the principal centres for visitors from the Continent, the Dominions and Colonies and the United States.

In regard to industry, the report concludes that the industries now established should not be subjected to any harassing restrictions, but every effort should be made to serve their welfare. On account of the historic character of Oxford, any tendency to develop it into a great industrial city is to be deprecated and should be forestalled. No heavy industries should be permitted to establish themselves and no sporadic industrial expansion should be allowed. Certain facilities should be given for the establishment of additional light industries, and any proposal that might be made for creating an industrial estate for this purpose should be considered sympathetically. The most valuable location for such an estate would be in the neighbourhood of Cowley, on land already zoned for industry in the Mid-Oxfordshire Planning Scheme.

According to the report, there are strong reasons for an entirely new departure in connexion with a civic centre. Such a centre should be designed so as to meet all the requirements of a modern municipality, and the error of cramping the site and leaving no room for future developments, committed by so many of our towns, should not be repeated here. Again, in regard to housing, the report stresses the importance of making sufficient provision for social needs in planning all new housing estates.

The committee has wisely included as an annexe to its report a report of the Oxford City Council's proceedings on the plan for redevelopment, which indicates the measure in which the Oxford Preservation Trust's proposals are likely to find local support. What emerges from this report is, in fact, the extent to which local opinion is ahead rather than behind Government action, and the general impatience at the slow progress under the Ministry of Works and Planning. This is notably true of several of the badly damaged towns which, following the example of Coventry, have been quick to realize the opportunities now to their hand for redressing past mistakes and errors.

The procedure suggested in the report is that the Oxford City Council—in conjunction with the two neighbouring County Councils, if they concur—might approach Parliament with a view to the passage of a special Act, for the establishment of a statutory commission to carry out such improvement scheme as might be adopted. The City Council should have the right to nominate a majority of the members of such a commission, on which both the County Councils of Oxfordshire and Berkshire as well as the University would be duly represented. The commission would have executive powers to carry out schemes in co-operation with the local authority concerned. Such a plan would avoid difficulties and delays which would otherwise occur from existing local boundaries, and would enable new financial sources to be tapped while protecting local interests. Any special powers for the acquisition of land could be embodied in the Act.

The broad outlines sketched above of the scheme for the re-planning of Oxford and its environs put forward by the Oxford Preservation Trust will serve to indicate the active interest which is being shown in the future utilization of the countryside of Great Britain. It is typical of many local efforts, which when integrated should make of the country a better place—a place in which both cultural and material needs are duly considered. The Ministry of Works and Planning must see that this local interest is fostered and, where necessary, guided to serve the needs of the country as a whole.

GOETHE'S SCIENCE

Goethe on Nature and on Science

By Sir Charles Sherrington. (The Philip Maurice Deneke Lecture, delivered at Lady Margaret Hall, Oxford, on the 4th March, 1942.) Pp. 32. (Cambridge: At the University Press, 1942.) 1*s.* 6*d.* net.

GOETHE is the only considerable poet who devoted much of his time to science and who took himself seriously as a man of science. Make no mistake, he took himself very seriously: he said, for example, to Eckermann, "I do not attach importance to my work as a poet, but I do claim to be alone in my time in apprehending the true nature of colour". Although he might on consideration have tended to revise this estimate of his poetry, it is abundantly clear from other records that he was convinced of the lasting importance of his writings on colour. Shelley took at one time a close interest in chemical experiments; Beddoes, a lesser, but not inconsiderable poet, spent most of his time in anatomical study, but neither of them thought that he had made a substantial contribution to science. Goethe stands alone.

Goethe invented the term 'morphology' and left sufficient mark in this study for him to be quoted more than once in D'Arcy Thompson's great work, "Growth and Form", in particular his aphorism "Das lebendige ist zwar in Elemente zerlegt, aber man kann es aus diesen nicht wieder zusammenstellen und beleben". His wide view of Nature as a living whole led him to make certain shrewd generalizations in the biological field which, while they have failed to win support, still retain an interest, but even in biology the one concrete discovery generally attributed to him, namely that of the intermaxillary bone in the human skull, was not new, having, as is pointed out in the study before us, been anticipated by Vicq-d'Azyr. It was to his investigations and speculations in colour, however, that he was particularly attached, and here his misunderstandings were so fundamental that the "Farbenlehre" has long been a puzzle to physicists, who have been unable to find a consistent or remotely reasonable point of view in it.

Goethe took as his fundamental phenomena those exhibited by light in passing through turbid media, such as colloidal suspensions; for example, that produced by adding a few drops of spirit varnish to water. Unfortunately, scattering phenomena are singularly ill-suited to serve as a starting-point for investigations or speculations on the fundamental physical properties of light and colour. No doubt Goethe was led to give them the foremost place in his teaching because colours due to scattering are particularly common in outdoor Nature, as exemplified by the red sun seen through fog or mist, the colour of distant hills and various phenomena in water containing suspended particles. It is also possibe that he may have been stimulated by de la Hire, who, about a hundred years earlier, put forward views rather similar to his own.

Goethe was an acute observer, and his descriptions of the colours due to scattering are numerous and precise. He attached, however, great importance to the background in observing the blue colour due to light scattered sideways, insisting that it should be black, since black played a great part in his theory. Although, of course, a black background makes observation easier, it is of no fundamental significance. This question of background is exemplified, for example, when, in explaining the colour of the sky, he says, "If the darkness of infinite space is seen through atmospheric vapours illuminated by daylight, the blue colour appears", which is, in a way, an anticipation of the true explanation of the colour of the sky, afterwards given by Rayleigh.* Goethe did understand that the blue of the sky was analogous to the blue of a beam of light in a colloidal solution.

How Goethe endeavoured to wring an explanation of all colours, including those of the prismatic spectrum, from the colours exhibited by scattering media is a long and complicated story of uncritical effort and obstinate misunderstanding. Whenever he was describing what he saw, however, he was clear and accurate, as in his talk of after-images and of simultaneous and successive contrasts. Physicists have been rather unjust to his descriptions of scattering phenomena, which were not properly understood before Rayleigh's fundamental work, and so certainly not by Goethe's early critics. He alienated men of science by his senseless and absurd attacks on Newton, whose point of view—that is, the modern scientific point of view—he was utterly unable to comprehend. He objected to mathematics as something that concealed the truths of Nature, and his ignorance and distrust of the quantitative often led him astray. In one experiment of his, for example, he objected that the red and the blue were not separated, which on Newton's theory they should be. Certainly they should, but a simple calculation shows that the angle between the red and blue ray should be only about a minute of arc, which he could not observe.

Goethe's antipathy to Newton's teaching led him to most ridiculous lengths: he not only accused Newton of deliberately misleading his readers, of "advocates' dodges" and "conjuring tricks", but even called him "a Cossack Hetman"—surely the most inappropriate term of abuse ever used. The very things on which Newton laid emphasis, precise quantitative experiment under carefully controlled conditions, were obnoxious to Goethe, who wanted to observe colours as they occurred in Nature. Newton probably seemed to him something like a Shakespeare critic who should try to explain the beauty and greatness of the poet's work by counting the frequency of occurrence of certain words, or investigating derivations. One does not find the essence of poetry by mathematics.

We are confronted with the question as to how a man of such mental power, vision and industry as Goethe could devote so much time to the problems of science without leaving any mark in the history of science, without being more, so far as his work on colour is concerned, than a psychological curiosity. Towards a solution of this question, which has been much discussed, especially by German writers, Sherrington's slender booklet contributes more than many ponderous works have done. The author is, of course, peculiarly fitted for his task. Not only is he one of the very greatest scientific figures of modern times, but also he is a poet of extreme sensitiveness, grace and perception, a man of profound knowledge and wide sympathies, a scholar, a linguist and, above all, a man of deep human understanding. What has he to tell us?

*"M. de la Hire says that the air, which is made white by the rays of the sun, appears blue on account of the black ground of the unenlightened space beyond it". Priestley, "History of Optics", 1772.

He points out that Goethe was a man with a very peculiar and personal view of Nature (not nature) and a man for whom sight was the predominant sense. He thought that Nature was not to be understood by the analysis of the laboratory and the mathematician's desk, but only by concentrating attention on certain *Ur-phänomena*, or bed-rock phenomena—sometimes Goethe speaks of *Grund-phänomena*—which were of especial significance and were open to direct observation. In colour the scattering phenomena (not, of course, so called by Goethe) were fundamental: we always see through media, more or less cloudy, and so the colours which cloudy media produce are of basic importance. In botany he attached great value to the conception of an ideal leaf which his highly personalized Nature always kept in mind. In the animal world she always had an ideal type before her: an advantageous departure from the type in one direction had to be counterbalanced by a disadvantage in some other direction. For Goethe, to attempt to understand Nature was to attempt to understand a personality, a divine personality if you will, but one taking an almost human delight in creation and device. In Sherrington's words: "For him, surely, the Nature he turned to, and addressed so often, was no impersonal principle, no causal concatenation of material forces. Rather, it was a numinous presence, immanent in Earth and Sky, operating the gates of birth and death."

This short thesis, every sentence of which is significant, really does lend a new meaning to Goethe's scientific work and shows it to be the product of a point of view which is consistent, even if utterly removed from that of modern science, as created by Newton. Goethe's labours in science have borne little fruit, but knowledge of them throws a strong light on the character and mode of thought of one who is undoubtedly among the few great writers of all time. The booklet which is now before us not only helps us to understand Goethe but also, which is just as important, to understand Sherrington. It will bring delight to all his admirers, that is to say, to all who know him or know anything of his work, for it shows the master still writing with all the clear imagery and vivid analysis, with all the generous emotion and keenness of perception which have at all times mitigated the severity of his scientific thought.

E. N. DA C. ANDRADE.

PROGRESS IN PHYSIOLOGY

Annual Review of Physiology

James Murray Luck, Editor; Victor E. Hall, Associate Editor. Vol. 4. (Published by the American Physiological Society and Annual Reviews, Inc.) Pp. viii+709. (Stanford University P.O., Calif.: Annual Reviews, Inc., 1942.) 5 dollars.

DESPITE the "ever-narrowing confines of the world in which we can enjoy the friendly intimacies of intellectual collaboration", to which the editors allude in their preface, the present volume is larger than most of its predecessors. One notes that the contents, always predominantly dealing with American work, are now almost entirely American except for references to a few pre-war papers. There is no ground for surprise in this; the numbers of investigators engaged in physiological research is far greater in the United States than elsewhere, at any time, and during the past three years one European country after another has closed down publication. Some of the contributors are more aware than others of work published outside the United States, while some appear to be quite unaware of non-American work; in any event it is unquestionably far outweighed by the large bulk of American work.

The volume contains references to nearly four thousand original papers, and to about the same number of authors' names: the task of selecting these from the enormous bulk of contemporary literature must have been enormous and thankless, though, of course, there is great variability in the available numbers of papers relating to the different reviews. The largest number no doubt are those papers that refer to the physiology of reproduction, and this review, by F. L. Hisaw and E. B. Astwood lists 486 references: in a relatively restricted field such as in the review on the physiological effects of neutron rays, by P. C. Aebersold and J. H. Lawrence, only thirty-one references are given. It is probable that reviews covering more restricted fields, such as that one, are able to quote a larger fraction of the published work than are the ones dealing with richer bibliographical resources. Further, the treatment in such reviews has the opportunity to cover its ground in a more leisurely and thorough manner, and so to be more generally instructive than that of the harrassed and overcrowded branches of the subject.

It would be difficult to pick out any of the reviews for detailed comment, since each is itself a condensation of so much. But one of them did impress the present writer by its originality, and by its suggestion of a new method of approach to physiological problems. This was the article on physiological psychology by Curt P. Richter. It deals with total self-regulatory functions in their relationship to Claude Bernard's concept of the maintenance of a constant internal environment. This constancy is attained not merely by partial physiological responses, but also by behaviour or total organism responses. For example, adrenalectomized rats will, if able, consume enough salt to keep themselves free of symptoms of adrenal insufficiency; diabetic rats took fat and rejected carbohydrate, and so on. After section of the taste nerves, adrenalectomized rats failed to distinguish between water and salt solutions. This behaviour drive opens up a method for the determination of metabolic needs, on the basis of "a little of what you fancy does you good", and instances of markedly unusual behaviour observed clinically may be considered as an expression of the drive to maintain a constant internal environment.

Another useful article is one on applied physiology, by Lieut.-Commander A. R. Behnke, U.S.N., and Captain C. S. Stephenson, U.S.N. This deals largely with various services problems, such as those connected with aviation, diving, submarines, etc. It is realized in the United States that "A prime need in the military service is the application of physiologic knowledge to field practice", and it is also acknowledged that in Germany this is realized to the full. In Germany, for the past five years, some twenty Government-supported laboratories were equipped with low-pressure apparatus for research in military flying, whereas for the same period the United States had only one physiological laboratory engaged in such work. This is a hint that might well be taken in Great Britain, in which the value

of physiology is little recognized, perhaps on account of political repercussions connected with the question of experiments on animals.

A mere list of the remaining articles must suffice, able and authoritative though these be. They are permeability, by L. R. Blinks; physiological aspects of genetics, by H. H. Strandskov; developmental physiology, by H. L. Hamilton and B. H. Willier; water metabolism, by J. P. Peters; growth, by G. S. Avery; energy metabolism, by W. H. Chambers, E. Shorr and S. B. Barker; the physiology of the skin, by P. C. Baird, jun., W. F. Lever, and T. D. Spies; the peripheral circulation, by A. P. Hertzman; heart, by M. B. Visscher; blood, by H. P. Smith; the digestive system, by E. J. Van Liere; kidney, by J. A. Shannon; electrophysiology, by R. W. Gerard; the spinal cord and reflex action, by T. C. Ruch; the central nervous system, by M. Hines; the autonomic nervous system, by K. Hare and J. C. Hinsey; sense organs, by H. K. Hartline; metabolic functions of the endocrine glands, by C. N. H. Long; and the pharmacology of drug addiction, by M. I. Smith.

The index is good and extensive, and the type and paper pleasing.

It would be a good feature in future editions if a bibliography of published books and monographs on physiology and cognate subjects for the year could be included as a special appendix. This would be of especial value at the present time, when so many are cut off from sources of information as to new publications.

C. LOVATT EVANS.

CELL RESPIRATION

A Symposium on Respiratory Enzymes

Contributors: Otto Meyerhof, Eric G. Ball, Fritz Lipmann, Kurt G. Stern, Fritz Schlenk, T. R. Hogness, Elmer Stotz, Carl F. Cori, E. A. Evans, Jr., Philip P. Cohen, K. A. C. Elliott, Dean Burk, C. J. Kensler, Erwin Haas, H. M. Kalckar, M. J. Johnson, Van R. Potter, H. G. Wood, R. H. Burris, C. H. Werkman, P. W. Wilson, F. F. Nord, Ephraim Shorr, A. E. Axelrod, Frederick Bernheim, E. S. G. Barron, Frederick J. Stare. Pp. xii+281. (Madison, Wis.: University of Wisconsin Press, 1942). 3 dollars.

IT has been said by Sir Frederick Gowland Hopkins that among the most fundamental of the dynamic chemical events related to life are the oxidations which yield energy to the cell. The study of the mechanism of cell oxidations does indeed seem to be developing into a main route to the understanding of the biochemical basis of life processes. This explains why so many biochemists are now devoting their energies to these problems, as the flood of individual publications shows. But whereas there are numerous excellent compilations on other similar fields, such as the vitamins, for example, collected opinions on respiratory mechanisms are comparatively few, and mostly the published accounts have been presented in support of one particular point of view.

The University of Wisconsin is therefore to be congratulated on having made a highly successful venture to fill this gap. With the University of Chicago, it inaugurated on September 11–17, 1941, a conference to consider the respiratory enzymes and the biological action of the vitamins. The lectures and discussions on respiratory enzymes given at Wisconsin have now been published in book form, and may be cordially recommended as a valuable guide to the present state of knowledge in this highly complex field. It is worth mentioning that no less than twenty-seven main contributors take part, almost all Americans or those for whose presence the scientific life of the United States is the richer and that of Germany the poorer. All are scientific workers of distinction in this field. This is not necessarily a guarantee of a successful symposium; but in this case the combination leaves little to be desired. Whether due to the genial atmosphere of Wisconsin, or to skilful though anonymous editing, the views of the various contributors are expressed with conspicuous clarity and forthrightness, and the text, not being encumbered with experimental or mathematical detail, is most readable. Sometimes the contributions overlap a good deal; this would be very irritating in a text-book, but this is essentially a book for the research worker and advanced student, and such are more likely to be inspired by its enthusiasm than put off by its lack of continuity in presentation.

On the whole it is rather surprising to find so much agreement on fundamentals. This would have been unthinkable only fifteen or twenty years ago, and is an indication that the subject of tissue oxidations is growing up, and leaving behind the controversial and uncertain. The points now at issue are for the most part concerned with the relative importance to be given to various alternatives, rather than with factual disputes. Much of this clarity is due to the application of physicochemical methods. E. G. Ball, of Harvard, gives a valuable review of the cytochrome-oxidase cytochrome system, and shows how the energy of oxidation instead of being explosively liberated is released in a series of at least six steps, the amount at each stage corresponding with the oxidation-reduction potential of the particular enzyme system concerned. Not only these potentials (except that of cytochrome oxidase) but also the amounts of the various catalysts in different cells and tissues are now known. Dr. Ball charts these potentials and gives an ingenious theory of respiratory poisons. Final elucidation seems to await the isolation of all components, particularly of cytochrome *b* and cytochrome oxidase, which it is necessary to remind ourselves are as yet available merely as crude suspensions of ground-up tissues. In later chapters E. Stotz discusses the detailed properties of the cytochromes, and K. G. Stern gives an excellent comprehensive account of oxidases, peroxidases and catalases. Among outstanding controversial issues needing clarification, is the question of the indispensibility claimed by some workers for the presence of oxygen for catalase activity, which is well reviewed by Stern. In other chapters the Pasteur effect is constructively discussed by F. Lipmann, and the individual nicotinamide and flavoprotein systems are described; T. R. Hogness gives an account of the important link between the single-electron cytochrome systems and the two-electron reduction of the nicotinamide coenzymes which is provided by the flavoproteins, particularly by cytochrome *c* reductase. These compounds seem to be able to do this by virtue of their semiquinone formation.

Metabolic cycles always seem to give trouble. It is noteworthy that the Szent-Györgyi system of hydrogen transport, which until recently occupied a commanding position in all discussions, has to some extent receded into the background. In the first place, rival schemes, particularly the Krebs citric

acid cycle and the discovery of carbon dioxide fixation in pyruvate metabolism, seem to have provided new and attractive alternative interpretations of some of the basic experiments of Szent-Györgyi, although Krebs himself has upheld the importance of this system. Secondly, hydrogen transport to the cytochrome system is now considered possible directly via flavoprotein from several intermediate metabolites, so that the same insistence on the essential transport by the succinate system does not seem to be regarded as necessary. A highly critical attitude towards the 4-carbon acid system is often noticeable, particularly by Hogness (p. 143) and Ball (p. 35); the latter rejects entirely as "a blind alley" the inclusion of the malate-oxaloacetate system into Szent-Györgyi's scheme. Whether the Krebs cycle really includes citric acid, or rather *iso*citric acid or some other intermediate is also debated. The application to bacterial metabolism of these cycles, and the importance in bacteria of carbon dioxide fixation, are discussed in valuable contributions from H. G. Wood and C. H. Werkman.

How, and to what extent, is this energy harnessed for use by the living cell? The positive evidence in this most difficult question seems to be limited to the part played by coupled phosphorylations, as exemplified by the obligatory coupling between the oxidation of triose and the phosphorylation of adenosine diphosphate. H. M. Kalkar and C. F. Cori individually discuss these and related problems. The latter shows how the phosphorylation of glucose depends on the aerobic formation of energy-rich phosphate bonds during the simultaneous oxidation of substances such as pyruvic, fumaric and succinic acids. The glucose so phosphorylated is now capable of breakdown to triosephosphate and pyruvate, and thus the cycle of glucose oxidation continues. In reviewing these important mechanisms, Cori directs attention to the fact that in the intact cell regulatory arrangements must exist integrating these activities; such regulators may well include many hormones, substances which do not themselves appear to be essential constituents of any enzyme system, but which may perhaps soon be fitted into this fascinating story. Another example of aerobic phosphorylation is provided by F. Lipmann, who shows that in the bacterial oxidation of pyruvate the highly unstable acetylphosphate may be isolated as the silver compound. Otto Meyerhof, now of the University of Pennsylvania, contributes a stimulating introductory article on intermediary metabolism, which includes numerous valuable suggestions for present-day attack.

Space does not permit more than a passing reference to the discussion on tumour metabolism: the reviewer is here on delicate ground, for the phrase "most authors agree . . ." which occurs several times in this chapter is perhaps an over-statement. But this section is worthy of serious study, and the pessimism of K. A. C. Elliott is well offset by the exuberance of Dean Burk. The latter boldly challenges all and sundry that he will diagnose tumour growth from its metabolism correctly in well over 95 per cent of cases, but perhaps this estimate of the accuracy may be lowered if many more normal tissues with "cancer-like metabolism" are discovered, and several are already known. No one seems to have given much attention in this section to the possible connexion between aerobic glycolysis and insufficient oxygenation *in vivo*, although Lipmann in his discussion on the Pasteur reaction has done so, and this may in the reviewer's opinion be as important a factor in tumours as it is believed to be in other tissues with aerobic glycolysis, such as cartilage, medulla of kidney, and intestinal mucous membrane.

Although there is much about carbohydrate oxidation and something about amino-acid oxidation in this book, the oxidation mechanisms which deal with fats, aceto-acetic acid and fatty acids are scarcely referred to at all.

The text is enlivened by numerous "candid" photographs of the participants. The general production is excellent.

F. DICKENS.

A RUSSIAN-ENGLISH DICTIONARY

New Complete Russian-English Dictionary (New Orthography)

Edited by Dr. Louis Segal. Pp. xii+965. (London: Percy Lund, Humphries and Co., Ltd., 1942.) 42*s*.

THE making of dictionaries is an evolutionary process; each new dictionary has or claims to have certain advantages over its predecessors that justify its appearance in the competitive struggle for existence, while the greater part of the reading matter must necessarily remain unchanged. The most obvious merit of Dr. Segal's dictionary, in comparison with earlier Russian dictionaries, is the clearness of the type; this is a most pleasing improvement. The use of the new orthography is an inevitable development which will be welcomed by the ever-increasing number of those who are unacquainted with the old, and the accenting of the Russian words will also be a help to the average English user.

A characteristic of many of the older Russian-English dictionaries is the frequent use of obsolete English words, as though the compiler (usually a Russian) of the dictionary was himself unacquainted with the evolution of the English language in the last two centuries and had slavishly copied earlier lexicographers whenever a difficulty or doubt as to the meaning of a word had arisen. It must be admitted that this most recent dictionary displays the same characteristic of archaism, the origin of which can easily be traced to earlier dictionaries, particularly Alexandrov's, to which the author acknowledges his indebtedness, and in which identical archaisms occur. Words like "eliquation" and "prase" defeated both the reviewer and the "Concise Oxford Dictionary"; one finds words such as "tetraphyllous" where "four-leaved" would obviously have been better, and so far at least as agriculture is concerned some of the translations betray a certain limitation on the compiler's knowledge of English agricultural terminology. Taking the dictionary as a whole, these are quite minor defects; the point is that they all occurred in the old, pre-Revolution dictionaries and have been incorporated unamended into the new. On the other hand, the translated idioms have been considerably increased in number (in comparison with the older dictionaries) and have been brought up to date.

It would have been advantageous to the majority of English students of Russian to have had some simple guide to the conjugation of verbs included in the brief section on grammar at the beginning. This is a part which might profitably be extended in a subsequent edition.

FIRST SIR JOSEPH J. THOMSON MEMORIAL LECTURE

WITHIN the generous curve of Faraday's horse-shoe table at the Royal Institution, almost every distinguished man of science has stood, at some time or another during the last hundred odd years, to deliver a "Friday Evening", or some other discourse. Some have been grim, and some have been gay, but none have been both in perhaps quite the same sense as Sir Joseph John Thomson.

The recent memorial lecture, under the auspices of the Chemical Society, given on April 16 from the same spot by the son of his predecessor in the Cavendish chair at Cambridge, is no ordinary tribute. Lord Rayleigh has produced something at once personal and vivacious, but at the same time historical. Three parts, very unequal in length, but all valuable, may be discerned. The first is biographical and completely charming. (Who can possibly forget 'J. J.' pushing his glasses up on to his forehead to look at something close at hand ?) The second is, in effect, largely an account of the search for the electron, and contrives to make the period 1870–1905 live again in retrospect. The third and shortest, depicts 'J. J.' as Master of Trinity. Many perhaps will wish that it had been longer, but for all that, one is glad to have it just as it is.

Our task now, however, is to meditate afresh upon the thirty-five years of activity to which Lord Rayleigh devotes the bulk of his address. Nevertheless, it is scarcely feasible to do this, without first of all recognizing the extraordinary intellectual strength possessed by the Cavendish professor. This characteristic is well brought out ; day after day he would go his rounds of some three dozen research students, hearing their individual troubles and setbacks, but ready almost immediately with counsel and answer to their problems. Lord Morley once remarked, "Never say never" ; certainly tradition has it that 'J. J.' never required any "notice of that question". Doubtless, in such an atmosphere as this came into being the powers of the Cavendish Laboratory—and all that it stands for, even apparent neglect not excepted—to train men for research.

Lord Rayleigh deliberately limits himself to discussing the era already indicated ; but more than this, he bids us look at it with the eyes of those who were in it and about it. This is most salutary. At once, the value of such an approach is manifest, for it enables the great controversy of the times concerning the nature of cathode rays (corpuscular or wave-like ?) to be apprehended as it appeared to contemporary thought. Since then, there has been much uncertainty, both in principle and in detail. But in those days, nothing blurred the sharp outline which divided the two schools. Cathode rays had to be one thing or the other.

There seems little doubt that what imparted the initial impulse to these investigations was the feeling that in a highly rarefied gas conditions were likely to be less complex than in liquids and solids. The kinetic theory, too, was at hand to help in getting a clear view in the mind's eye of what exactly was happening. Hittorf apparently was the first to observe phosphorescence around the cathode. Meanwhile, broadly the British school—Varley, Crookes, Kelvin, to whom should be added George Francis Fitzgerald—upheld the corpuscular theory, whereas Lenard, Hertz and others on the Continent supported the wave-nature interpretation. Lenard showed that cathode rays could penetrate a thin aluminium window. This was something of a reverse for the corpuscular upholders, but Thomson inclined to the opinion, Lord Rayleigh says, that an explanation might be found in the generation of a derived stream of particles on the far side. In 1895 Perrin performed his well-known experiment (somewhat akin to Faraday's ice-pail) and Thomson made a crucial extension to it. In these ways it appeared inescapable that cathode rays were in fact transporting negative electricity, and were thus essentially particles. The final stages, leading up to (m/e), need no recapitulation here.

It is noteworthy that Thomson was always somewhat attracted by the border-country between physics and chemistry ; indeed a dissertation having a strong sympathy in that direction won him his fellowship at the first attempt. Seen at this angle, it is more than fitting that such a lecture as we are now considering should have materialized under the ægis of the Chemical Society. Perhaps with this in view, Lord Rayleigh dwells almost exclusively upon his subject's distinction as an experimenter. But Thomson's contributions to mathematical physics were no less remarkable ; for example, the discovery in the early 'nineties of electromagnetic momentum. In this may be seen a pre-condition for the rise of the great edifice in recent years, associated particularly with the names of Born and Dirac. Altogether, truly a momentous achievement. Then in 1918, on the advice tendered by Mr. Lloyd George to the Crown, 'J. J.' left the Cavendish for Trinity Lodge, there to gain new affections and new triumphs of a different kind ; and so it was, until the end came on August 30, 1940, in his eighty-fifth year.

F. IAN G. RAWLINS.

CYTOLOGICAL CRITERIA OF MAMMALIAN ENDOCRINE ACTIVITY

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A CONSIDERATION of the development of endocrine histology throws considerable light both upon the problems which have confronted the investigator and the way in which attempts have been made to solve them. When the physiological significance of the endocrines was less understood than it is now, their histological descriptions were relatively simple. For example, in the anterior lobe of the pituitary two chromophilic and one chromophobic type of cell were described. As the gland came to be investigated in the light of an increasing knowledge of its physiological activities and with improved techniques, the complexity of the histological picture increased. Transition cells between chromophobe and chromophil have been recognized in many animals investigated[1,2,3], and in the dog[4] dark and light varieties of the basophil cells have been described, as have special carmine acidophils in the cat[5]. In a like manner, the original principal and oxyphil cells of the human parathyroid[6,7] have each been divided into two types—dark and light ; osmiophilic and non-osmiophilic cells have been described in what

was originally considered as the uniform parenchyma of the rat parathyroid[8,9], and I[10] have observed a somewhat similar differentiation with intermediate cell types in the mouse. Again, in the human pancreatic islets Gomori[11] has recorded cells intermediate between *A*-cells and the *D*-cells of Bloom, and Hoerr[12] and others have described dark and light cells in the zona reticularis of the adrenal cortex.

The attempts to explain the apparently increased histological and cytological complexity of various endocrines have resulted again in an effort at simplification. The present tendency is to discover whether the apparently different cell types of a gland are not in reality phases of a cycle associated with secretory activity. This concept has focused attention on individual rather than mass cellular changes within the gland, and has opened up what may become a more profitable approach to the subject—that of physiological cytology.

The more specifically cytological attitude to these problems has resulted naturally in a search for reliable criteria of cellular activity. Of these the most obvious were the stainable intracellular granules, such as those of the acidophil and basophil cells of the anterior pituitary, which, largely by analogy with the specific granules of the pancreas and similar exocrine glands, have come to be regarded as prosecretion granules, and hence their density in a cell has been looked upon as a function of its secretory activity. Although this is a reasonable assumption and has so far proved satisfactory as a working hypothesis, there is as yet no histochemical evidence (at any rate for the anterior pituitary among endocrines) to support the identification of the granules with the secretion or its precursor. Somewhat similarly in the adrenal cortex—where there is evidence that the cortical cells originating perhaps from fibroblast-like cells in the capsule move radially through the cortex until they finally become senescent in the zona reticularis[13,14]—variations in the size and concentration of osmiophil droplets in the cells of the different cortical zones have been used as an index of cellular activity[15,16]. Similar correlations might perhaps be made with the phases of development and regression of the corpus luteum[17] in relation to its fat and lipoid content and physiological activity. As is pointed out later, there is some evidence derived from microchemical tests that the lipoid material in the adrenal cortex is in part associated with sterol compounds.

In addition to a consideration of these labile cell contents, interest has been increased in the permanent cell parts such as the mitochondria and the Golgi material. Enough evidence has now been produced to remove any doubts as to their real existence[18,19], but very little of a precise nature is known of their chemical constitution. Various workers have reported the mitochondria as containing, in addition to lipoids (of which there is but little according to Bensley[20]), protein[21], vitamin A[22], vitamin C[23] and glutathione[22]. A possible protein component has also been suggested for the Golgi body[19,24]. What little is known of these cell organelles is at present of little value in elucidating their role in secretory activity, but that the Golgi bodies do have a role is becoming increasingly evident. The topographical relation between the Golgi apparatus and the secretion products is not so clearly established in most endocrine as in exocrine gland cells, but there is some evidence for such a relation in the thyroid gland, where 'pro-colloid' droplets have been recorded in the Golgi area[25,26]. Nevertheless the close topographical association in the pancreatic acinus cell, for example, between the Golgi material and the neutral-red vacuome or prozymogen substance[19,27] has strengthened the concept of a similar relationship between secretory activity and the Golgi body in endocrines as well. Additional suggestive evidence is furnished by (1) Bowen's[18] demonstration that in certain animals the acrosome granule of the sperm originates in a vacuole which is in intimate contact with the Golgi material; (2) the observation of Severinghaus[28] and others[29] that the Golgi area (in anterior pituitary cells, for example) is often vacuolated, and (3) the fact that the walls, or the area in proximity to the walls, of the contractile vacuoles of certain Protista blacken with osmic acid[10].

A marked polarization of the Golgi body is generally a characteristic of exocrine gland cells, this structure being between the nucleus and the surface at which the secretory products are discharged. The only endocrine which shows anything like a fixed polarity is the thyroid, where the body is between the nucleus and the follicular lumen. Since the thyroid is by origin a gut diverticulum, and possibly only secondarily a gland of internal secretion, this is perhaps to be expected. Cowdry[13], however, maintained that the position of the Golgi body was a reliable index of the direction of secretory release, its occasionally reversed position in the guinea pig, for example, being indicative of secretion directly into the capillaries. This may be the case for the thyroid, but there is no satisfactory evidence in support of a fixed capillary polarity in epithelioid glands such as the anterior pituitary and parathyroid, where the observations are conflicting[19], or in the islet tissue or adrenal cortex. Thus the question of the polarity of the Golgi body in endocrines as a whole is at the moment too controversial to be admitted as evidence of its participation in secretory activity.

Since it has been established that in exocrine glands the Golgi body hypertrophies during secretory activity[19]—for example, in the parotid gland—the endocrines have also been examined from the same aspect. Generally speaking, activation results in hypertrophy of the Golgi body. This occurs, for example, in the thyroid gland after the injection of anterior pituitary extracts[32,33], in pancreatic islet cells after œstrone injection[34], and in the rat parathyroid[35] after the experimental induction of low calcium and low phosphorus rickets respectively. Similarly, there is some evidence to show that inactivation of a gland may result in a shrinkage of the Golgi body; this, for example, has been reported in the rat parathyroid after parathormone injection[8]. Whether, however, Golgi body hypertrophy or its reverse is to be correlated with a corresponding increase or decrease of secretion formation, with secretion release, or with both, is by no means certain.

The anterior lobe of the pituitary gland provides the most satisfactory material for an analysis of this problem, since there are records not only of the state of granulation of the chromophil cells in relation to physiological activity, but also of the condition of the Golgi material. Severinghaus[3], on the basis of the study of human material stained under carefully controlled conditions, has produced evidence to show that, both in acidophil and basophil cells, there is a regular cycle of granule depletion ending in a chromophobic state, followed by a granule accumu-

lation resulting in the restoration of the chromophilic condition. This process continues, presumably, until the cells become senescent. Thus, the state of complete granulation is to be regarded as a phase in a cycle which marks the end of synthesis and the beginning of secretory release. This fact needs to be established in other animals; Kirkman[1], for example, working with the guinea pig, was able to trace the stages in the degranulation of the basophil cells as well as their development from small chromophobes (as was Severinghaus[2] in the rat), but the mechanism of granule replenishment was not determined.

Apart from these observations, there are no others similarly based on staining reaction sufficient to disprove an alternative interpretation of the functional nature of the granulated chromophil cell. It could be argued that the granules represent merely a surplus prosecretion, so that if synthesis and release proceed at the same rate there will be no change in the degree of granulation, and degranulation will be due to a temporary increase of release over synthesis. Should this be the actual state of affairs it would imply that granulated as well as degranulating cells may be actively releasing hormones and consequently the interpretation of variations in the histological composition of the gland in relation to its activity would become a problem of extremely great complexity. These matters in relation to the activity of certain exocrine glands have been considered in some detail by Hirsch[36].

Further light, however, is thrown on this subject when the relation of the degree of granulation to the state of the Golgi body is considered. If the evidence already cited (and it is only a small part of it) justifies the assumption that increased secretory activity—whether of synthesis, release, or both—is associated with Golgi body hypertrophy, then the Golgi bodies of any cells in an active secretory state, whether granulated or degranulating, should show some degree of hypertrophy. An examination of the records of glands specially impregnated to show the Golgi material definitely gives the impression that there is no hypertrophy in fully granulated cells. This is further emphasized by the fact that it has been shown that the 'typical', that is, fully granulated, acidophils and basophils of the rat have characteristically shaped Golgi bodies readily distinguishable from each other[2].

Similar observations have been made for the cat by Atwell[37]. These differences would probably have been difficult to establish had there been any considerable hypertrophy together with a secretory activity existing in such granulated cells, for such a condition would presumably have tended to reduce the morphological differences between the two Golgi types. It might, of course, be argued that secretory activity in the normal anterior pituitary is not associated with any marked Golgi body hypertrophy, that produced by experimental methods such as the injection of œstrogens being an abnormal state due to over-stimulation. Hagquist[38], however, studying the cytological changes in the anterior pituitary of the female guinea pig during its reproductive cycle, has reported a loss of granules in both types of chromophil cell as occurring about the eighth day of the cycle, accompanied by a marked and progressive hypertrophy of the Golgi material. Such a rhythmic process indicates that hypertrophy during secretory activity is characteristic of the Golgi body and supports the conclusion that the cycle of the chromophil cells is essentially one of alternating granule accumulation and granule loss.

In addition, it may be noted that in glands where there is no reason to believe that activity is markedly rhythmical, such as the pancreatic islets[39] and the parathyroid[8,10], the Golgi body is found to present varied configurations indicative of varying states of activity in the same gland. Therefore from such evidence as has been presented it may reasonably be inferred that in the anterior pituitary, and probably in the thyroid, parathyroid and pancreatic islets, secretory activity is associated with Golgi hypertrophy even under normal conditions. There is, of course, the possibility that in the islet tissue variations in the Golgi body morphology may be associated with the different cell types, but this is a question yet to be investigated.

The relation of the Golgi body changes to the two phases of secretory activity is more difficult to determine, and most of the available data again relate to the anterior pituitary. Theoretically, the best approach to this problem would be to investigate the effect of slowing down or stopping experimentally one or other of the two phases. There is evidence that in the female rat heavy doses of œstrogens inhibit the release of gonadotrophins, since atrophy of the ovaries results[40]; yet the cytological picture is one of great activity—degranulated cells and hypertrophied Golgi bodies[29, 28]. Presumably in this case a state of exhaustion has been produced resulting from a stimulation of secretory release far in excess of synthesis. This at first sight suggests a correlation between the Golgi material and secretory release. There is no proof, however, that the greatly enlarged Golgi bodies may not have been correlated with an initial increase of synthetic activity and afterwards maintained by an even greater secretory release. In other words, it still allows of the possibility that Golgi hypertrophy is associated with both phases of activity.

Gonadectomy in some animals produces changes which some have considered as being in part antithetic to those resulting from œstrogen injections. In the rat, castration results in two distinct changes, the one being an increase in the proportion of basophils, due according to Pomerat[41] to an increase in mitotic activity of the pre-existing basophils, the other the appearance of characteristic vacuolated castration cells. Similar changes have been reported in rats after artificial cryptorchidism[2, 41] and in dogs after the injection of canine antihormone[44]. It has been suggested by Severinghaus[28] that castration vacuolation might be due to a granule solution resulting from an augmentation of secretion production and an inhibition of its release. If this is the case, as seems reasonable, the hypertrophy of the Golgi material during the early phases of vacuolation (for there is a regression later on) suggests that it is associated with secretion production. But, again, there is no proof that castration does not involve an initial transitory increase of secretory release. Finally, in describing the transition from the inactive small chromophobes to the basophils in the guinea pig, Kirkman[1] records that, just prior to the appearance of the granules, the Golgi body hypertrophies and the mitochondria become scattered, and Hagquist[38] for the same animal indicates that there is some hypertrophy during the process of granulation in chromophils, although the maximum is attained during degranulation, where there is also the greatest mitochondrial dispersion. Thus the scanty data

available do not permit of any conclusion, but suggest that the Golgi body is involved in both phases of secretory activity. The thyroid gland contributes little to the elucidation of the precise role of the Golgi body, because its study is complicated by the problems of colloid release from the follicles, in which the Golgi material may also participate.

In regard to the function of mitochondria in secretion, an increase in their number is associated, for example, with the degranulating chromophil cells of the anterior pituitary of the rat[23] and guinea pig[1] during pregnancy, and after œstrone administration in the rat[23]. It has also been noted previously that changes in the mitochondrial dispersion in relation to the state of granulation occur in the guinea pig. In the thyroid, Okkels[33], and Bailiff[26] observed a massing of mitochondria in the apical poles of the cells following upon the stimulation of secretion into the follicular lumen. Okkels[33], from his observations, suggested that the mitrochondria acted as condensers of the secretion. Other workers have recorded changes in the mitochrondrial morphology of the thyroid, following upon experimental treatments. Seecof[45], and Cramer and Ludford[25] described a filamentous condition resulting from stimulation induced respectively by partial thyroidectomy and low temperature. The same workers observed a conversion into a granular state consequent upon a reduction in cellular activity. These observations certainly indicate that the mitochondria have a role in secretory activity, but there is insufficient evidence to show its precise nature.

Finally, in the adrenal cortex there are no records of changes in the mitochondria and Golgi material which could be correlated with secretory activity. There is, however, evidence to show that when the activity of the cortex is stimulated experimentally, by exposure of the animal to cold, for example, there follows an initial increase of lipoid material followed by a decrease, as the stimulation is maintained. Flexner and Grollman[16] regarded this initial increase of lipoid as being indicative of increased activity. On the other hand, Dosne and Dalton[15], interpreting similar results, regarded the initial increase as a kind of compensation reaction, further increase in activity being accompanied by lipoid loss. This interpretation is supported by the investigations of Bennett[47], who has produced evidence which indicates that the adrenal cortex of the cat may be conveniently divided into four zones, on the basis of their lipoid content, and on their reaction to a histochemical test designed to show the presence of the keto-groups of the cortical sterones. He found that the reaction was practically confined to that zone of the cortex (consisting of part of the zona fasciculata) which is richest in lipoids—this he called the secretory zone. Since it was found also that removal of the lipoid with suitable solvents resulted in an inability to detect the keto-groups, he concluded that there was probably an intimate relation between the two, so that if stimulation of the cortex brings about a rapid release of the cortical hormone, the progressive disappearance of the lipoid droplets is thus to be expected.

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AGRICULTURAL RESEARCH INSTITUTES AND THE FUTURE

By DR. B. A. KEEN, F.R.S.

THE organization and administration of agricultufal research, in common with many other national activities, will receive critical—and, it may be hoped—constructive attention as a result of the War. Although the post-war structure of our agriculture cannot yet be predicted with confidence, considerable changes will probably occur, which should be accompanied—and so far as possible, anticipated—by appropriate new perspectives in the agricultural research, advisory and teaching organizations.

This article deals primarily with research and is further restricted to arable agriculture. Although other branches, such as animal husbandry and economics, also have their own vital problems, it is not likely that their framework of organization and administration will need to be vastly different from that proper to research in arable agriculture. Indeed, there are so many problems requiring joint examination that some organization to serve those needs that are common to all branches is not only desirable, but also essential.

If one looks back at, say, the last hundred years of research in arable agriculture. a clear pattern can

be seen, especially in Great Britain. There have been two well-defined stages, the second of which is already changing into a third. The picture is one of orderly and progressive development, and the third stage is a logical outcome of the second.

It so happens that the history of Rothamsted well illustrates the sequence. The first stage—the era of Lawes and Gilbert—was a frontal attack on a problem of practical agriculture: the manuring of crops. The method was one of simple and direct field experiments; the function of the laboratories was to produce a mass of expository analytical data on the soils and crops. It is true that valuable novelties were employed in the method of approach: the problem was detached from its context of crop rotations and agricultural systems by growing each crop continuously. The method well served its purpose, for it was quick, and it not only gave striking new information on crop nutrition but the field results were capable of immediate application to practice. The effects of artificial manures on crop yields were so large that they were not wholly obscured even by widely different soils, climates, and agricultural systems. Lawes and Gilbert took little or no direct part in the repetition of their experiments in other areas. Examination of the increasing mass of the Rothamsted data occupied the greater part of their attention; for very many years Gilbert was absorbed in the nitrogen balance sheet for the various plots and in the amounts of nitrogen that could not be accounted for when the analyses of soil, manure, crop, rain and drainage were put together. Had the study of soil microbiology been as well forward then as agricultural chemistry some of the puzzles would have been clearer. However, the important point was that the conclusions and their technical corollaries might have only a local validity; but the full realization of this was to come only later. The effort, in fact, was somewhat like an attempt to make a synoptic chart for our variable continental-seaboard weather from very detailed meteorological observations taken at a single station.

With the deaths of Lawes and Gilbert the first stage of agricultural research closed. The Rothamsted work had shown that agricultural science had extended beyond the scope of any one man. The need for the help of a microbiologist in a problem that began in chemistry has already been mentioned; and, while biochemistry could advance the frontier of agricultural chemistry, it was, in turn, handicapped by lack of knowledge of the physical environment in the soil. Clearly, the help of research workers in many branches of science was needed if soil and plant relationships were to be further elucidated. This second stage of agricultural research began with modest resources, but the Development Commission, and especially the War of 1914–18, gave it a great impetus. It has now been running for some twenty years in substantially the form planned by its designer, the late Sir Daniel Hall. Weaknesses and merits have had time to show themselves, so a review of the organization is appropriate, the more so in view of the many war and post-war agricultural problems.

In this article it is unnecessary to set out the achievements of the second phase of agricultural research. To any unbiased observer they must amply justify the faith of Hall's vision, for the boundaries of agricultural science have been greatly enlarged. To take only one section, a comparison of the original 1912 edition of Russell's "Soil Conditions and Plant Growth" with the seventh, of 1937, shows in striking fashion how far we have travelled in twenty-five years and how much British agricultural scientists have contributed to that progress. The annual reports and papers published by other research institutes—those dealing with market gardening and fruit growing, for example—show equally striking advances in their own spheres of work.

It is important to study the organization under which this work was done. There were some obvious difficulties to overcome: specialists tend to work in water-tight compartments, and few of the new men were likely to have any agricultural background. Thus there was the double problem of fostering team-work so that the new agricultural science should be a coherent whole, and of providing a suitable environment to ensure that technical applications of the scientific advances would not be missed or ignored by the research workers.

Superficially, one single large research institute for the whole of agricultural science would have seemed the solution, but for two inescapable facts: first, agricultural research embraces such widely different activities as animal nutrition, farm economics, plant genetics, and soil physics; and second, effective central direction of research, whether by a director or a committee, is impossible if the number of workers exceeds a certain limited figure. The alternative adopted was a number of smaller institutes, each of which took an agreed broad section of agricultural research as its main concern. A possible looseness of contact between these sections was less important than the reasonable certainty that within each section team-work would build up a coherent picture. Another far-seeing provision was to give each institute the widest freedom of control over its own research programme, for the reason that decentralized control works best. In the past twenty-five years many members of the institutes have studied the organization of agricultural research in other countries, and many overseas visitors have examined our scheme; the almost universal opinion is that none is better than ours and most are less effective.

Nevertheless, no one, least of all those in the research institutes, would claim that the present organization should be continued unchanged merely because it has been successful in the past. Should they be consulted about their own future—and it is to be hoped that they yet will be—it would assuredly be found that those concerned with arable agriculture are anxious that the third stage of agricultural research should be organized, for its pattern and requirements are already quite clear.

The very advances of the second stage showed that many technical conclusions obtained for one soil, climate and agricultural condition were either invalid, or needed modification, elsewhere. To meet this difficulty some of the institutes had built up chains of experiments as best they could. The problems investigated were necessarily restricted, as only the simplest field procedure could be used. Their scope was further limited because the problems had to be those of immediate interest to official or private organizations able to meet some of the costs and to help in securing sites. Although the experiments were simple, incomplete, and beset by various difficulties, they were amply justified by their results both in agricultural science and practice. The overriding needs of war-time agriculture have removed,

for the time at least, some of the difficulties: contacts with other institutes and advisory officers are increasing, and an informal network of co-operative field experiments (and demonstrations) is developing. For the first time there emerges a possibility of joint work on some important agricultural problems not included within the interests of official and private organizations.

The freedom of development that characterized the second stage of agricultural research has not only produced the third stage as a logical outcome: it has also provided the technical machinery that makes the next stage possible. The statistical design of experiments to secure comparable results of an ascertainable degree of accuracy enables the maximum of information to be obtained from a given amount of experimental effort, by combining several related questions in one design. Thus, problems concerning two or more research institutes could be dealt with in the same experiment. Such a scheme of field experiments would need co-operative control by the interests concerned through a committee which might work under the ægis of the Agricultural Research Council. The committee would be responsible for selecting the programme from the various proposals put forward and for combining the selected problems in the most economical manner. Each experimental site would be typical of an important soil and farming system.

It is certain that a system of well-distributed replicated experiments will be of the utmost value to the research institutes. It is equally certain that it will enable rapid answers to be given to many urgent post-war agricultural problems of a practical and economic nature, for, as already stated, it is growing up even now under the compelling pressure of immediate war-time problems.

Wars and their aftermaths are conducive to centralized control of many activities. The majority of research workers regard such controls as temporary necessities which have an unfortunate tendency to persist after the need for them has vanished. Lest it should be thought that the scheme outlined above is merely another fashionable war-time centralization, it is desirable to stress the following points: the need for it was apparent before the War; it is a natural development from a second to a third stage of agricultural research. Finally, it does not call for any significant changes in the control and administration of the research institutes. Their record during the twenty-five years of the second stage of agricultural research, and the fundamental work now in hand and projected, are enough to show that they are still efficient instruments in the furtherance of agricultural science.

As stated at the outset, this article deals only with the organization and administration of research in arable agriculture. Contacts with colleagues in various other branches lead me to believe that among agricultural research workers there is general agreement on the situation briefly discussed here and on the best method of dealing with it. But agricultural science ranges so widely that workers in other branches will have their own proposals to offer for the general plan of research organization. One purpose of this article is to promote discussion in these columns and elsewhere, in the belief that a common ground of agreement will emerge; there is no doubt that, especially at the present time, such discussions and expressions of opinion will be very opportune.

OBITUARIES

Dr. Arnold Berliner

The death occurred, on March 23, of Dr. Arnold Berliner, well known to the scientific world as the founder and editor of *Die Naturwissenschaften*.

Berliner belonged to the first generation of 'technical physicists' and worked in close connexion with Emil Rathenau as head of the physics laboratories of the A.E.G. during the period of rapid expansion of this firm. The development of the incandescent carbon lamp and of X-ray bulbs owes much to him—he introduced the first 'getter', phosphorus, in the manufacture of lamps, and the large scars on his arms bore testimony of the early stages of experimenting with X-rays when their dangers were not yet realized. Among other technical problems advanced by Berliner was that of the phonograph: he was the first to introduce the disk form for records (1889).

As an author Berliner was successful with a textbook on physics which appeared in several editions. It is conspicuous for stressing the application of physical knowledge to technical problems, many years in advance of a recognized 'technical physics'. In "Physikalisches Handwörterbuch", edited by Berliner and Scheel, many of the articles defining concepts or describing methods used in physics are from Berliner's pen.

These and other literary products, sound as they are, have not attained the importance of Berliner's creation of *Die Naturwissenschaften* in 1912. Framed on the model of NATURE, for the achievements of which Berliner had the greatest admiration, this journal for general science was to draw closer together the physical and the biological, the experimental and the descriptive sciences. Berliner addressed himself mainly to the then young generation of men of science. Much of the success of the journal was due to Berliner's vivid personality, his close contact with the majority of young physicists and mathematicians and his initiative in formulating the subject of articles he wanted written for his journal. Thus *Die Naturwissenschaften* became a mirror reflecting the development of science during 1913–30. To what extent the success of the journal depended on its editor became apparent when his work became limited by a serious eye trouble which made reading nearly impossible to him for many years. His field of vision was filled with a misty haze; after having vainly consulted many oculists, Berliner found the physicists' solution of eliminating much of the light diffusely scattered in his eye by filtering away the short-wave part of the spectrum and reading by red light only.

Berliner's desire was to complete the twenty-fifth volume of *Die Naturwissenschaften*, his very own creation. In the "Aryanization" of the publishing firm of Julius Springer, the old man was turned out of his office in 1935. He had since lived a life of reminiscence of his many friends—artists, men of science and politicians. Various attempts to find a new home outside Germany were unsuccessful. Now his friends deplore in his tragic escape from life the loss of one who represented much of the best cultural traditions of a bygone Germany, and of a warm-hearted and helpful friend. P. P. EWALD.

DURING the years following the War of 1914–18, Arnold Berliner was a prominent figure in German

science. There was no Naturforscher-Versammlung and no meeting of the Physikalische Gesellschaft where his small but powerful figure with the characteristic beard and big spectacles did not appear, no scientific conference where his wise counsel was not welcomed. He never claimed to be a man of science, but only a "poor technician". But he insisted that every article in *Die Naturwissenschaften* should be written in such a way that his "simple mind" could understand it. How few of the contributions proved up to the high standard which he set, and how lively was the ensuing correspondence! He had a collection of the most remarkable extracts from these letters, as material on the "psychology of the scientist", whom he liked to describe as "mimosenhaftes Stachelschwein" (a hybrid of mimosa and porcupine). Perhaps he did not realize how well this description fitted his own character, which was the strangest mixture of infinite kindness, generosity, greatness of outlook and personal touchiness.

He was a technician by profession, an amateur scientist; but his real life was in literature, art and music. He read abundantly and remembered everything. He knew all the great galleries of Italy and Germany, and filled his home with good modern pictures. But his greatest pleasure were his annual visits to the Bach, Beethoven, Brahms festivals and to Bayreuth. Of his numerous friendships with men of importance he valued none higher than that with Gustav Mahler, the composer. Music was left to him when the decay of his eye-sight deprived him of reading and enjoying art. Finally, even music was taken from him, for going to concerts became impossible for a Jew. The work of his life was broken and his last years were lonely, dark and tragic. Many of his friends were dispersed over the globe. But he will not be forgotten by them. MAX BORN.

Prof. A. L. Selby

ARTHUR LAIDLAW SELBY, born on July 2, 1861, at Atherton, Lancashire, was the eldest son of Atherton Thomas Selby. He was educated at Heversham Grammar School and at Queen's College, Oxford. He was a fellow of Merton College from 1886 until 1893, and examiner in the Honour School of Natural Science in 1889–90 and 1900–1. He married Dorothy, daughter of Ernest Beck of Great Amwell.

After holding an assistant demonstratorship in physics at the Clarendon Laboratory, Oxford, for six years, Selby was in 1890 appointed assistant professor of physics at Cardiff University College, becoming professor of physics in 1897. He occupied this chair for twenty-nine years, retiring in 1926 with the title of professor emeritus. During his sixteen years of retirement he continued to reside in Cardiff, and maintained the closest possible touch with the College. He died on July 22 last, at the age of eighty-one. He is survived by his widow.

It would be vain to attempt in a short obituary notice to do justice to the manifold services rendered by Selby to the University College at Cardiff, to higher education in Wales, and to the many students who have passed through his department. His personality, his clear and unbiased judgment, and his inimitable command of phrase, marked him as a leader in committee and as an inspiring lecturer in the class-room. His transparent honesty of purpose and his sympathetic understanding rapidly gained for him the confidence of his students and colleagues, and he never failed to win the lasting affection of those who worked with him.

His name will be perpetuated in the series of Selby Lectures, and will be held in affectionate remembrance by all who knew him. R. T. DUNBAR.

NEWS and VIEWS

Anglo-Soviet Scientific Collaboration Committee

IT is now four months since the formation of the Anglo-Soviet Scientific Collaboration Committee under the chairmanship of Sir John Russell. The Committee came into being as a result of a conference held last March at the Royal Society to discuss the development of contacts between British and Russian scientific workers. With Sir John Russell as chairman and Mr. J. G. Crowther as vice-chairman, the Committee arranged that scientific communications should be forwarded to the U.S.S.R. according to the following procedure. Letters addressed by individual British men of science to individual Russian men of science, or communications from British scientific and technical societies to the corresponding Russian societies, can be sent either to Sir John Russell, Ministry of Information, Malet Street, London, W.C.1, or to Mr. J. G. Crowther, British Council, 3 Hanover Street, London, W.1, who will take the necessary steps to forward the communications to the U.S.S.R. This amplified the machinery for exchange of scientific information with the U.S.S.R. already set up by the British Council.

A number of communications have already been forwarded to the U.S.S.R. in this way, but owing to the time taken in transit and the inevitable dispersion of Soviet scientific workers, and the evacuation of scientific institutions in the Soviet Union, it is realized that it may be some time before replies reach Great Britain. In collaboration with the University of London School of Slavonic Studies, the Committee has arranged for special Russian classes for scientific workers. In this way, many young scientists are being encouraged for a moderate fee to learn the Russian language. The Committee has fully realized the importance of a satisfactory exchange of scientific literature between Great Britain and the U.S.S.R., and as a basis for this has recommended that a survey shall be undertaken of the war holdings of Russian scientific and technical periodicals in Great Britain, with details of location and accessibility. The British Council has agreed to finance the survey, which will be organized by ASLIB. The survey is already under way, and it is hoped that it will be completed in two months time. Librarians of scientific institutions are now asked to co-operate in this important piece of work by completing and returning their questionnaires as soon as possible. When the survey is completed the Committee will endeavour to obtain from the U.S.S.R. the periodicals still being published in the Soviet Union, but which no longer reach Great Britain.

In view of the urgent demand for a Russian-English technical dictionary, the Committee is making a collection of existing glossaries of Russian technical and scientific terms in Great Britain and the United States, with the idea of placing a complete set in

the Science Library in London, where they can be consulted. If at a later stage it should be found possible to compile a new Russian-English technical dictionary, these glossaries will form a valuable basis to work on. A location list of Russian technical dictionaries is also being compiled, and scientific workers are asked to assist in this by sending to the Secretary of the Committee a list of dictionaries in their possession. Several scientific societies and individual men of science have approached the Committee concerning the provision of a panel of Russian scientific translators. The Committee has already collected together the names of several qualified Russian translators, and is prepared to receive names of reliable translators for inclusion in the list.

What Constitutes a Nation ?

WHAT constitutes a nationality is as hard a question to answer as the allied one of what is denoted by the word race. J. R. Swanton, in *Smithsonian Institution War Background Studies*, No. 2, has presented the problem clearly in a manner the non-expert can readily grasp. Obviously many factors go to the formation of a nation : common physical type, geographical background, governmental unity, language, religion, economics, etc. But when the major cultures of the world, both past and present, are considered it will be found that no one of these is a dominant factor. There are true nations where the physical types are hopelessly mixed, as well as other factors which one would have thought vital to unity. On the other hand, even one of the more important criteria, namely, language, can fail to be a binding element—as witness England and the United States. Here, though the language is the same, no one can deny that there are two distinct nations. On the whole, the author seems to be driven back to the idea of the importance of voluntary associations of folk living under a government desired by the majority. This is, of course, difficult to test in the case of past civilizations, but seems to be applicable to modern nations. But if so it cannot be too much stressed, indeed it is the keystone of the theory, that what one nation may desire, in fact what may be the cement that makes it a nation, may not be at all what appeals to other agglomerations of men and women whose nationality will be determined by a totally different outlook on life.

Industrial Health Research Board

THE Medical Research Council has appointed the following to be the members of its Industrial Health Research Board during the period 1942–45 : The Rt. Hon. the Earl De La Warr (*chairman*), Prof. F. C. Bartlett, Brig.-Gen. A. C. Baylay, Dr. J. C. Bridge, Dr. A. N. Drury, Dr. T. Ferguson, Dr. M. W. Goldblatt, Dr. A. Bradford Hill, Dr. Donald Hunter, Prof. Esther Killick, Air Vice-Marshal Sir David Munro and Mr. J. L. Smyth. Prof. A. W. M. Ellis, director of research in industrial medicine under the Council, will also attend all meetings. Dr. R. S. F. Schilling, one of H.M. medical inspectors of factories, has been seconded to the service of the Council by the Ministry of Labour to act as Secretary of the Board. The terms of reference of the Board have recently been revised and are now as follows : "To advise and assist the Medical Research Council in promoting scientific investigations into problems of health among workers, including occupational and environmental factors in the causation of ill-health and disease, and the relation of methods and conditions of work to the functions and efficiency of body and mind ; and in making known such results of these researches as are capable of useful application to practical needs."

Jean-Baptiste Van Mons (1765—1842)

ON September 6 occurs the centenary of the death of the once famous Belgian chemist and horticulturist Jean-Baptiste Van Mons who died at Louvain in 1842 at the age of seventy-six after a life entirely devoted to science. Born in Brussels on November 11, 1765, when Belgium was under foreign domination, he lived to see Austrian rule give way to French and French to Dutch, and then in 1830 to see his country gain her independence. But under every regime Van Mons steadily continued his work and it was largely through his labours that discoveries made in France became known in the countries with which she was so frequently at war. By profession Van Mons was a pharmacist, but when twenty years of age he wrote an essay on the new principles of chemistry and he subsequently corresponded with Lavoisier, Fourcroy, Monge Hachette and others. By the French authorities he was entrusted with a survey of the Belgian mines and in 1797 was made a professor at the central school of the department of Dyle. On the invitation of the French chemists he assisted in editing the *Annales de chimie* and in 1801 founded the *Journal de chimie et de physique*. By his own contributions to these and to the periodicals of Gren, Crelle, Brugnatelli, Nicholson and others he spread abroad a knowledge of the work of such as Volta, Vauquelin, Fourcroy and Chenevix. He was the first to introduce vaccination into Belgium, and all his life he experimented on the improvement of fruit trees. When the Belgian Academy was revived in 1816 Van Mons was nominated to a seat and the following year he was made professor of chemistry and agriculture in the restored University of Louvain. This post he held until 1836. Of his sons, Louis-Ferdinand Van Mons (1796–1847) was one of the chief artillery officers of Belgium and Charles-Jacques Van Mons (1798–1837) was professor of pathology in the University of Brussels.

Francis Adams (1796-1861)

UNDER the title of "A Great Country Doctor", the June issue of the *Bulletin of the History of Medicine* contains a lively article by Prof. Charles Singer on Francis Adams of Banchory, the son of a village labourer who rose to be one of the greatest medical scholars of his age. His principal achievements were a translation of "The Genuine Works of Hippocrates" (1849), which Prof. Singer describes as "probably the most widely read of any work on medical history in the language" ; "The Seven Books of Paulus Aegineta" (1844–47), which "retains to this day its position as far and away the finest venture in pure historical medical research in the English language" ; and "The Extant Works of Aretæus the Cappadocian" (1853), which unlike the other two works contains the Greek text as well as the translation. His minor publications include articles to medical journals, translations of Horace and Musaeus into English verse, of Gray's "Elegy" into Latin, and of Wolfe's poem on Sir John Moore into Greek. He also collaborated with his son, Dr. Leith Adams, F.R.S., in a paper read before the British Association at Aberdeen in 1859 entitled "On Ornithology as a Branch of a

Liberal Education", and contributed to Dunbar and Barker's "Greek and English Lexicon" (1831), Lemprière's "Classical Dictionary" (1838), and Greenhill's "Theophilus" (1842). Adams was not only a great scholar but was also an excellent doctor. "His first love and his last", says Prof. Singer, was his practice, his patients and the poor." His devotion to his profession was best shown by his declining the chair of Greek at the University of Aberdeen, which afterwards gave him an honorary doctorate. He paid several visits to Oxford and London, where he made friends with many learned men, particularly James Quain and William Sharpey, the founders of the modern academic teaching of anatomy and physiology in England. Dr. Singer ends his fine essay by saying that though the ranks of general practitioners in Britain have produced many eminent men of science, such as J. A. Lockhart, Sir James Mackenzie and J. A. MacMunn, none of equal distinction as a scholar practised in so isolated a locality as Adams.

A Pilot-Channel Regulator for the K-1 Carrier System

VARIATIONS in attenuation of the cable conductors used for the K–1 carrier system are compensated by corresponding changes of gain under control of a pilot-wire regulating system. Since these changes in attenuation are due primarily to temperature changes, and since all pairs in the same cable are approximately at the same temperature, a pilot regulation system—in which the gain over the various pairs is adjusted to conform to the temperature of one pair of wires in the cable—is a simple and satisfactory way of handling the regulation. There are, however, certain minor deviations from pair to pair for which such a system will not provide, and with long circuits over, say, some five hundred miles, some additional regulation will be needed to take care of these residual deviations.

An article by J. H. Bollman (*Bell Lab. Rec.*, **20**, No. 10; June, 1942) describes a regulator using thermistors as controlling elements, supplementing the normal regulating system. The new regulator operates on pilot channels rather than on a pilot-wire. Currents of single-frequency are transmitted over a pair of conductors, the gain being regulated in accordance with the attenuation changes of these pilot channels. Regulation is thus directly associated with the carrier system operating on that pair. The change in gain is the same at all frequencies. Regulation as designed is used not only to compensate for the residual regulation errors of a 300–500 mile circuit, but also to take care of the flat regulation of the previous repeater section (12–20 miles) and also the slope and bulge regulation of the previous twist section (50–300 miles), obviating the necessity for pilot-wire and twist regulators. Measurements over a four-monthly period, using continuous recorders, showed that variations in the net losses of the twelve channels due to changes in line loss were not more than 0·5 db., an improvement of more than two to one as compared to the performance previously available without the deviation regulator.

Overheating of Electric Motors

AN article on this subject in the *Electrical Review* of July 31 opens with a brief survey of overheating due to dirt or other foreign matter obstructing the ventilating pipes, ducts and passages of motors. Mention is made of the lagging effect which waste materials may have on the motor casing, and useful suggestions are given for the improvement and maintenance of ventilation. Since the rate of heat generation is proportional to the square of the load, protection against overloading is advised. It is suggested that motors be protected by a tripping device operating at 25 per cent sustained overload, or thermostatically controlled if subjected to large rapid load fluctuations. The liability of cotton insulation to char at about 100° C. is mentioned in stressing the safe temperature rise of a winding as being about 72° C. above that of the surrounding atmosphere.

The author then outlines the effects of accidentally sustained starting currents, mentioning in this connexion the mal-operation of star-delta starters. Warnings are given against running D.C. variable-speed motors at abnormal speeds; series connecting the windings of small A.C. motors intended for use on two voltages when on full load; prolonged connexions of the starting windings of split-phase single-phase motors; and the running of polyphase motors with one phase of the supply open-circuited. The remainder of the article is devoted to interesting points in maintenance, attention being directed to worn bearings, lubrication, short-circuited windings, short-circuiting of commutators by carbon dust, and the careless handling of dismantled machines as possible causes of overheating. Attention to the many points referred to will doubtless minimize the risk of overheating, rapid deterioration and breakdown of the plant.

Rats and the War

ACCORDING to the *Medical Officer* of August 15, Dr. Charles White, medical officer of health for the City of London, has recently issued a report to the effect that while the devastation caused by enemy action has undoubtedly reduced the rat population, particularly in the Cripplegate area, in other districts there is still severe infestation by these vermin. Premises previously more or less free now suffer constant infestation, especially buildings in which the upper floors only were damaged by fire or blast. The hundreds of sandbag blast walls have formed a safe harbour for rats, but many have now been replaced by brick structures. Infestation by rats has been aggravated by the introduction of fire-guarding and consequent indiscriminate feeding, as well as by leaving doors open throughout the buildings to facilitate fire-guards access to rooms. Dr. White recommends that when structural reconstruction is considered adequate steps should be taken to construct rat-free buildings.

The National Trust

IT is satisfactory to learn from the forty-seventh annual report of the National Trust for Places of Historic Interest or Natural Beauty that progress is being made in spite of the War. The recent outstanding addition to the Trust's properties is the Wallington estate in Northumberland, but while this is the largest (13,000 acres) there are many other interesting and beautiful places now saved for the nation in no less than twelve counties. The report, which is also concerned with problems of future upkeep, preservations of buildings and amenities, and of the plant, fish and even bird life of Ullswater, can be obtained at 7 Buckingham Palace Gardens, Westminster, and is a cheering document to turn to in this time of strife and destruction.

Post-war Medical Relief

IN a timely pamphlet (Post-War Problems Medical Relief in Europe. The Royal Institute of International Affairs, 1942. Pp. 67. 2*s*. net.), Dr. M. D. Mackenzie emphasizes the importance of organizing before the end of the War a central co-ordinating administrative machine composed at first of delegates of the allied countries and later of representatives of occupied countries as well. He suggests that the Health Organisation of the League of Nations, which still functions, should be used and should be joined by international voluntary organizations (International Red Cross, Society of Friends, etc.), British and American voluntary organizations for relief in Europe and the national voluntary organization in each of the countries to which relief is being given. In addition to food and clothing, medical relief material of all kinds will be wanted, including vaccine against smallpox and enteric fever, disinfectants, quinine and other important drugs, as well as re-establishment of the milk supply. The specific diseases which will need attention are malnutrition including tuberculosis, typhus fever, malaria and other infectious diseases as well as cardiac and digestive disorders.

Smallpox in the United States

ACCORDING to an annotation in the June issue of the *Statistical Bulletin*, the organ of the Metropolitan Life Assurance Company of New York, a remarkably low record for smallpox was established for 1941 in the United States, only 1,432 cases having been reported in the whole country during that year, or scarcely more than half the number notified in 1940 (2,795). In Canada also the incidence of smallpox was very low, only 26 cases having been reported, all but one of which occurred in the single province of Saskatchewan. As in previous years, the type of the disease in the United States was mild, and it is probable that not more than ten deaths occurred. There is good reason to believe that the present decline is real, and that the disease will be eradicated in the next decade. During the past twenty-one years, nearly half a million cases of smallpox have been reported in the United States, one State alone, Indiana, being represented by 37,902 cases. The chief centre of smallpox infection in the United States recently has been in the north-west corner of the country which comprises the States of Montana, Washington, Idaho and Oregon, while the lowest incidence is in the New England and Middle Atlantic States, followed by the States in the south-east corner of the country. The high incidence in Indiana is to be attributed to the fact that at a recent survey less than 13 per cent of the Indiana pre-school children and not more than 53 per cent of school children less than ten years of age were found to be vaccinated. It is therefore highly desirable that the following warnings should be widely spread: (1) no one is naturally immune to smallpox; (2) protection against it must be acquired artificially by vaccination; (3) the immunity conferred by vaccination is not life long, but must be renewed by revaccination at intervals of seven years or when an outbreak of smallpox occurs.

Recent Earthquakes

ON August 24 an earthquake of considerable intensity caused destruction in places 50 miles apart in southern Peru. The epicentre of the shock was probably a little distance to the north-west of Acari, which is a town in the foothills of the Andes in the province of Arequipa. The town of Acari was almost destroyed and there are reported to be large numbers of dead and injured. At Nazca, a town some 50 miles north-west of Acari, one third of the buildings were completely destroyed and 80 per cent of the population are homeless. Here 20 people are reported to have been killed and several injured. At the coast near the port of Nazca the sea receded some 200 yards and then came back and flooded the port together with about 1,000 yd. of the Pan-American coastal highway. The shock was well recorded at Stonyhurst College Observatory, near Blackburn; the Rev. J. P. Rowland, *S.J.*, reads *ePg* at 23h. 03m. 37*s*. U.T. on August 24, the maximum ground amplitude at Stonyhurst being 600 μ at 39m. 40*s*. U.T. The shock finished recording at 04h. 10m. U.T. on August 25, all the interpretations being tentative.

The seismograph at Stonyhurst also recorded another earthquake, this time on August 27 at 06h. 18m. 40*s*. U.T. The record was well defined, but the amplitudes were much smaller than those of the Peruvian shock, and the epicentral distance from Stonyhurst much less. The German radio has reported an earthquake in Albania. In one village 80 per cent of the buildings are said to be uninhabitable, and many people killed and injured.

Announcements

SIR JOHN ORR, director of the Rowett Research Institute, Aberdeen, has been appointed professor of agriculture in the University of Aberdeen. He will retain the directorship of the Institute.

THE Minister of Agriculture and Fisheries has appointed Mr. F. A. Secrett to be honorary adviser on vegetable production. Mr. Secrett is the head of Messrs. F. A. Secrett and Co., the well-known firm of vegetable growers. His wide experience and intimate knowledge of the industry will be invaluable to the Ministry in the work of increasing the production of home-grown vegetables.

THE next meeting of the Parliamentary and Scientific Committee to be held in Room 6 of the House of Commons, at 2.45 p.m. on September 8, will consider, among other things: "further action to be taken on the Motion now on the Order Papers of the House with a view to the setting up of a central Technical and Scientific Board; to consider representations from a representative from the Geological Society with regard to the better use of geology in connexion with the war effort."

FOLLOWING the conference held at the Institution of Civil Engineers on August 25 to discuss generally the question of civil engineering and the building industry, discussion meetings will be held at four-weekly intervals beginning September 15 at 2.30 p.m., to consider the specific problems that emerge. Mr. George Hicks, Parliamentary Secretary to the Ministry of Works and Planning, will be the principal speaker at the first meeting. Particulars and tickets for a particular meeting or for the series may be obtained on application to the secretary of the Institution of Civil Engineers, Great George Street, Westminster.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Antipressor and Depressor Effects of Oxidation Products of Pressor Amines

PRESSOR amines comprise a great variety of β-substituted primary and secondary alkylamines the cyclic portion of which may contain one or two phenol groups. The various functional groups determine the catabolic fate of these amines which, in turn, contribute to the nature, intensity and duration of their action. Because of the role attributed to pressor amines in essential[1] and in experimental[2] hypertension, the mechanism of their inactivation and destruction is of pathological and pharmacological interest.

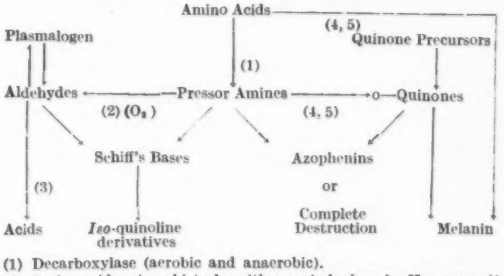
(*a*) Oxidative mechanisms can attack either the side chain or the cyclic portion of the pressor amine molecule. Oxidation of the latter leads from, or through, catechol derivatives to *ortho*-quinones and eventually to melanins. The formation of *o*-diphenolic compounds by enzymatic or other chemical and by physical means in the animal body from monophenols is still obscure[3,4]. The *ortho*-quinones, known as intermediaries in melanin formation[5], may also undergo azophenine-like condensations with additional amine molecules. Thus, the destruction and physiological inactivation of additional molecules of pressor amines is accomplished.

Schroeder and Adams[6] lowered the blood pressure in experimental hypertension by injection of mushroom tyrosinase. This effect is attributable either to complete enzymatic oxidation of the phenolic pressor amines or to their inactivation by the *ortho*-quinoid intermediaries formed in the course of tyrosinase action. The latter alternative is supported by the lowering of blood pressure in experimentally hypertensive rats and dogs after injections of the quinone precursor dihydroxyphenylalanine together with small amounts of copper salts as oxidation catalyst[7]; analogous *in vitro* experiments demonstrate that pressor amines (tested in crucial experiments on cats) are destroyed by aeration with quinone precursors and also with aliphatic enediols in the presence of heavy metal catalysts[7]. Adrenochrom, a cyclized *ortho*-quinone derived from adrenaline, is also known as a hydrogen acceptor in vital oxidation processes[8] and its 'trigger action' upon certain effects of adrenaline illustrates the physiological operation of a catechol-*ortho*-quinone system. Preliminary experiments[9] with injection of relatively stable halogenated adrenochrom derivatives show an antipressor effect in experimentally hypertensive rats and dogs.

(*b*) Kisch[10] has shown that the aeration of solutions of amino acids and dipeptides in the presence of adrenaline and other quinone precursors such as hydroxyquinol results in oxidative deamination. Beyer[11] obtained analogous results with ascorbic acid, an aliphatic diketone precursor. Thus, in Kisch's experimental model an intermediary product of nuclear oxidation catalyses in its turn a side chain oxidation.

(*c*) Enzymatic oxidation of the side chain of pressor amines is accomplished by amine oxidase found in kidney, liver, brain and other organs. This enzyme was discovered by Hare[12] who demonstrated its effects on tyramine *in vitro*. The products of oxidative deamination are ammonia and the corresponding aldehydes, in the case of tyramine, *p*-hydroxyphenylacetaldehyde. The aldehydes formed by the action of this enzyme are subject to further oxidation by the hepatic xanthine oxidase to the corresponding acids, which have so far not been found to be of physiological significance. This, however, is not the only reaction which these aldehydes may undergo. Mrs. M. Hare Bernheim[13] discussed the potential condensation of one molecule aldehyde with another molecule of unchanged amine to a Schiff's base. Again, as in the case of the *ortho*-quinoid primary destruction products, the formation of the aldehydes does not mean only the removal of one molecule of pressor amine, but produces an additional antipressor effect by condensation of the aldehyde with a second molecule of amine to a physiologically inert compound. These Schiff's bases are, in turn, subject to cyclization yielding *iso*-quinoline derivatives along the line of the papaverine synthesis of Robinson[14]. These *iso*-quinoline derivatives are related to the fast-acting alkaloids of the papaverine and laudanosine group. Their formation could explain the depressor effect of homoprotocatechuic aldehyde, the deamination product of hydroxytyramine, observed by Holtz[15]. A similar chemical transformation of adrenaline into a substance of antagonistic properties may account for the so-called diphasic action of adrenaline injections[16]. Especially the infusion of minute amounts accentuates this antagonistic action as the rate of transformation exceeds the rate of direct action.

The subjoined diagram shows that the various possible oxidation products of pressor amines may have: (1) an antipressor effect by inactivating additional amounts of pressor amine; (2) a depressor effect as in the case of *iso*-quinoline derivatives and perhaps their aldehydic parent substances; (3) the final oxidation products such as melanin and aromatic acids are indifferent, and there is finally (4) the possibility of storing a physiologically active intermediary in a temporarily inert state.



(1) Decarboxylase (aerobic and anaerobic).
(2) Amine oxidase (aerobic), also with creso-indophenolas H-acceptor[12].
(3) Xanthin oxidase.
(4) Monophenolase and (5) catecholase.

Aldehydes are known as rather reactive substances unlikely to persist in living tissue. Certain aliphatic aldehydes, however, have been found by Feulgen[17] in lipoid extracts of muscle, blood and viscera bound by cyclic acetal linkages in the so-called plasmalogen. This acetal phosphatid upon hydrolysis liberates plasmal, a mixture of aldehydes, including stearic and palmitic aldehyde. The presence of aldehydes other than these saturated higher aldehydes has been suspected by Feulgen[18]. Attempts in collaboration with H. Sobotka to isolate aldehydes from hog kidney have resulted in the identification of stearic aldehyde[19],

but also indicate the presence of mixed aromatic-aliphatic aldehydes. An interchange may exist between these two classes of aldehydes and they may replace each other in acetal phosphatides. Striking differences in the occurrence and distribution of bound aldehyde in normal and pathological kidneys from human autopsies speak for the physiological significance of stored aldehyde[19]. Thus, aldehydes with antipressor and depressor effect may be conserved in this form, so that they may be mobilized for various needs of the organism. These aldehyde depots can be depleted in tissue sections by incubation with aromatic amines such as sulphanilic and *para*-aminobenzoic acids and may serve a similar purpose of local detoxification *in vivo*. They would be especially suitable to combat undesirable accumulations of pressor amines. Thus they may function as temporary 'buffers' delaying the onset of experimental hypertension which, in spite of the immediate production of renal ischemia, appears only three or four days after the Goldblatt operation.

The above diagram illustrates the hypothetical sequences of reactions from cyclic amino acids through pressor amines, antipressor and depressor substances to inert end-products. The equilibrium between these transformations, obtaining under physiological conditions, is disturbed in renal hypertension; the pressor amines then accumulate and at the same time their antagonists are depleted and used up. Extracts with depressor effect have been obtained from normal kidney[20]. In experimental unilateral renal ischemia in dogs[21] the production of the antagonists in the intact kidney prevents the persistence of hypertension in spite of the continuous output of pressor amines from the ischemic kidney.

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*George Blumenthal, Jr. Fellow. Partly supported by a grant of Messrs. Winthrop Chemical Company.

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Self-incompatibility in Certain Diploid Potato Species

Pal and Puskar Nath[1] have reported that the diploid ($2n = 24$) potato species, *S. arrac-papa*, *S. Caldasii*, *S. chacoense*, *S. Jamesii* and *S. subtilius*, are self-incompatible. Under Cambridge conditions the diploid species, *S. Rybinii*, *S. boyacense*, *S. lanciforme* and *S. phureja*, also appear to be self-incompatible.

Only one clone of *S. Rybinii*, which Salaman[2] states he was unable to infect with either leaf roll or potato virus *Y*, has been brought to Europe, and on selfing this clone never sets berries. It will, however, cross readily with the closely related species *S. boyacense* (clone *E.P.C.* 546), which also does not set berries on selfing. Berries containing a very large number of seeds are obtained from this cross and from the reciprocal. Also, as is shown in the table, F_1 plants from the cross are cross-compatible with either parent. It has not, however, been possible to show that only four types of F_1 plants, such as would be expected on a simple oppositional factor hypothesis, are produced.

		Female Parent					
		S. Rybinii	*E.P.C.* 546	$F_1$4	$F_1$6	$F_1$8	$F_1$10
Male Parent	*S. Rybinii*	–	+	+	–	+	+
	E.P.C. 546	+	–				
	$F_1$4	+		–		–	
	$F_1$6			+		–	+
	$F_1$8	+	+	–	–	–	+
	$F_1$10	+	+		–	+	–

+ = compatible pollination; – = incompatible pollination; $F_1$4, 6, 8, and 10 = F_1 (*S. Rybinii* × *E.P.C.* 546).

No berries have been obtained from selfing any of the clones of the blight-immune, Mexican diploid species *S. lanciforme* which was brought back by the Empire Potato Expedition as seeds. Berries containing numerous seeds have, however, been obtained from the following crosses between clones, *E.P.C.* 40·3 × 40·4, *E.P.C.* 40·3 × 40·7, *E.P.C.* 40·4 × 40·3, *E.P.C.* 40·6 × 40·3 and *E.P.C.* 40·6 × 40·4.

Similarly, two clones of *S. phureja*, *E.P.C.* 1307 and *E.P.C.* 1310, have never set berries on selfing, but berries with seeds were obtained from the cross *E.P.C.* 1310 female × *E.P.C.* 1307.

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H. W. HOWARD.

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Aug. 16.

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[2] Salaman, R. N., *Indian J. Agric. Sci.*, **8**, 119 (1938).

Effect of Sulphanilamides on the Growth of Micro-organisms in Presence and Absence of *p*-Aminobenzoic Acid

LAST year I presented some results of experiments on the antagonism between *p*-aminobenzoic acid and sulphanilamides (sulphanilamide, sulphapyridine and sulphathiazole) in autotrophic organisms[1]. These experiments were carried out with two strains of the freshwater diatom *Nitzschia palea* var. *debilis* (Kg.) Grun. I also made experiments on the inhibitory action of sulphanilamide on the growth of *N. communis* Rabenhorst, *N. Kützingiana* var. *exilis* Grun. (f. *multiplex*[2]) and further strains of *N. palea* var. *debilis*.

The growth of the diatoms, which were cultured on a substrate used by me[2] earlier[3] and known to be free from anti-sulphanilamide factors, was more inhibited by sulphanilamide than by sulphapyridine, which in turn had a somewhat stronger effect than sulphathiazole. In other words, the action of the sulphanilamides mentioned on the growth of the diatoms was the reverse of that on bacteria.

The antagonistic power of *p*-aminobenzoic acid on sulphanilamides in these experiments with diatoms was, however, similar to that in corresponding experiments with bacteria, the inhibitory activity being strongest against sulphanilamide, less strong against sulphapyridine and least against sulphathiazole. Although *p*-aminobenzoic acid probably is an essential metabolite (in the sense of Fildes[4]) for diatoms as well as for bacteria and fungi, the conditions—at least for the diatoms investigated—seemed to be more complicated, and it was assumed that the pyridine and thiazole groups of sulphapyridine and sulphathiazole made these influence also vital processes in the metabolism of the cell other than those connected with the *p*-aminobenzoic acid (cf. the opinion of West and Coburn[5] concerning the competition of sulphapyridine with nicotinic acid in the formation of coenzymes).

A connexion between my experiences with diatoms and the results from the investigations on bacteria was seen when Landy and Dicken[6] reported their experiments on the neutralization of sulphanilamides through *p*-aminobenzoic acid in yeast. Their growth diagram shows a crossing between the sulphanilamide and sulphapyridine curves, indicating that at certain higher concentrations of *p*-aminobenzoic acid the growth of yeast is less inhibited by sulphanilamide than by sulphapyridine, whereas at lower concentrations the reverse is true. This probably explains my own experiences with diatoms, although the response to sulphathiazole does not seem to be identical in the two groups of organisms.

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Rapid Determination of Fat in Animals and Plants

THE living organism or tissue is weighed, preferably by the displacement method[1], and placed in a weighed Soxhlet thimble. It is then distilled under xylol and the percentage of water estimated[2]. Any fat will remain in the xylol. A further extraction is carried out with xylol in the ordinary Soxhlet extractor and then the whole of the xylol used is made up to a litre or some other standard volume. Then 200 ml. of this xylol is placed in a round-bottomed flask together with about 200 ml. of distilled water and steam-distilled.

The vapour pressure of the xylol being well above that of steam and that of the fat being well below, the fat remains in the flask and the xylol is carried over. The water and fat from the flask are washed out into a separating funnel while still warm and allowed to cool. A small amount of hydrochloric acid is added to bring about demulsification and the whole is shaken up vigorously with petroleum ether. The fat dissolves and is estimated in the ordinary way by evaporating off the petroleum ether.

The method has been tested out thoroughly with lard and pure olive oil. It is obviously limited in its application but has the great advantage that it is unnecessary to dry the material containing the fat.

If a little of the original material is first steam distilled it will be seen at once if it contains volatile oils or fats and if it does the method is clearly unsuitable.

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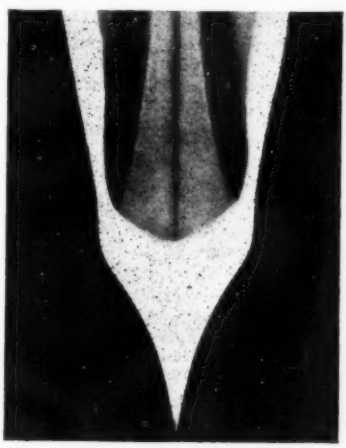
[1] Lowndes, A. G., NATURE, **141**, 289 (1938).
[2] Lowndes, A. G., NATURE, **148**, 594 (1941).

Luminous Radiation from Hot Gases

THE question as to whether normal gases become luminous when heated is of the greatest importance to those interested in the physics and chemistry of flame gases. Pringsheim did a great deal of work with the view of deciding this, and found that they remained dark at the highest temperature he could command in the laboratory[1]. In recent books by Lewis and von Elbe[2] and Gaydon[3], however, doubt is expressed whether at temperatures of the order of 2,000° C. they would still remain dark.



I think there is no doubt that they would. Weston's spectrograms from carbon monoxide – air flame gases and the higher temperature carbon monoxide – oxygen flame gases show that when hydrogen is added, the characteristic carbon monoxide flame gas spectrum disappears—even though the flame gas temperature is higher[4]. The explanation would appear to be that, with addition of hydrogen, the carbon dioxide produced is much more normal, for it has been shown that the latent energy in carbon monoxide flame gases decreases with addition of hydrogen. (Gaydon suggests that the luminous radiation from carbon

monoxide flame gases results from continual recombination after dissociation of the carbon dioxide. Weston's experiments do not appear to support this view, for a large amount of dissociation and recombination must be taking place in the high temperature carbon monoxide – hydrogen – oxygen flame gases.)

A further indication that hot normal carbon dioxide does not emit luminous radiation may be derived from flame photographs, which show remarkable variations in the intensity of the after-glow in carbon monoxide flame gases resulting from explosions in a glass tube. One such photograph taken by Dr. A. S. Leah is reproduced herewith. His experiments have shown that the temperature of the gases showing almost negligible after-glow is higher than that of the gases in the immediate neighbourhood which show a strong after-glow. There can be little doubt that the carbon dioxide in the former gases is much more normal than the carbon dioxide in the latter gases[5].

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[2] "Combustion Flames and Explosions of Gases" (Cambridge University Press, 1938).
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Diffraction of Ultra-Short Radio Waves

WE have pointed out[1] that ultra-short radio waves polarized with the electric vector vertical are propagated into the shadow of hills more readily than horizontally polarized waves. We have since observed the opposite effect for receiver positions beyond hills but just outside their shadow. Fig. 1 represents

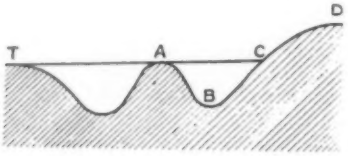

Fig. 1.

roughly the terrain over which these results, shown in the table, were obtained. The transmitter T was near the top of one ridge and the field strength investigated over the region $ABCD$; horizontally and vertically polarized radiation was emitted in turn from the transmitter on a wave-length of 3 metres, and the aerial at the receiver oriented to correspond for each measurement with the appropriate transmitter polarization. Over the region ABC within the geometrical shadow of the ridge having a crest at A, the vertical electric field, in agreement with our earlier note, was greater than the horizontal field, the ratio of these two fields, as will be seen from the table, being unity near the edge of the shadow at A and C and a maximum near the bottom of the valley at B. Just outside, however, the horizontal field was greater than the vertical, the ratio showing a flat maximum.

These experimental results are similar to those found both theoretically[2] and experimentally[3] in the diffraction by a straight edge or wedge of radiation in the visible spectrum. As the radius of the curvature of the ridge in our experiments was large compared with the wave-length, similar results would be obtained if the obstruction caused by the ridge is assumed to represent that due to the earth's curvature. It may be concluded, therefore, that for an elevated transmitter T (Fig. 2) and receiver positions

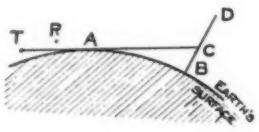

Fig. 2.

within the shadow ABC cast by the earth's curvature, vertical polarization should be used, but for positions just outside that shadow, horizontal polarization is more efficient. Horizontal polarization may, in practice, be the better for transmitter and receiver positions such as T and R (Fig. 2) well within optical range of one another if R is at such a height as to be just outside the shadow caused by the continuous diffraction due to undulation of the ground, houses, etc. In addition, horizontally polarized radiation may be better over tree-clad country, under the above conditions, on account of the materially greater attenuation caused by trees to vertically polarized radiation at ultra-short wave-lengths.

Position	Field-strength in microvolts per metre		Ratio Vertical/ Horizontal fields	Remarks
	Vertical polarization	Horizontal polarization		
1	32,000	31,000	1·03	Position *A*
2	6,300	4,100	1·54	
3	2,500	950	2·63	in shadow
4	1,200	500	2·40	
5	1,080	530	2·04	Position *B*
6	1,900	1,400	1·36	
7	7,900	8,400	0·94	Position *C*
8	9,800	11,500	0·85	
9	12,000	19,700	0·61	
10	9,800	17,500	0·56	outside shadow
11	6,500	9,800	0·66	
12	2,000	2,220	0·90	
13	740	710	1·04	Position *D*

The work described above was carried out as part of the programme of the Radio Research Board, to which this note was first circulated as a confidential report, on March 11, 1940. It is now published by permission of the Department of Scientific and Industrial Research.

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[1] McPetrie, J. S., and Saxton, J. A., NATURE, **144**, 631 (1939).
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Frequency of Dust-storms in the Egyptian Desert

WHEN I reviewed[1] the book by Lieut.-Colonel R. A. Bagnold on the "Physics of Desert Sands and Dunes", I noted a statement by the author that dust-storms, as distinct from sand-storms, were of comparatively rare occurrence in the Egyptian desert, whereas dust-storms were being reported in the news as interfering with the fighting in the Middle East every few days. At the time, I regarded the term 'dust-storm' as being somewhat loosely applied by the reporters, and to include sand-storms, but I have recently had the opportunity of reading a paper[2] by Prof. F. W. Oliver which throws new light on this point. Prof. Oliver has lived since 1935 at Burg-el-Arab, thirty miles west of Alexandria, and he states that changes have occurred in recent times. The average dust-storm frequency from 1935 to 1939 was 5 a year over the period January to May; in the same period of 1940 there were 8, and in 1941 there were 32 storms. The total number for the year 1941 was 54, and in addition to the increased frequency, the severity was much greater.

Prof. Oliver accounts for this increased frequency first by the surface disturbance caused by war operations in the desert, such as construction of fortifications and movement of lorries; and secondly, by the removal of cover, that is, desert scrub, which was destroyed by the Bedouins when they evacuated from the district. He considers that extensive measures will need to be taken after the War to abolish the dust nuisance in these districts.

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[1] NATURE, **48**, 480 (1941).
[2] "Some Remarks on Desert Dust-Storms". By F. W. Oliver. Pp. 16. (Alexandria: Whitehead Morris (Egypt), Ltd., 1942.)

Social Reporting

IN the review of Mass-Observation's recent report "People in Production"[1], the main theme of this report seems to have escaped the reviewer's attention.

What "People in Production", a report on six months study in war factories, analyses out is a fundamental psychological tendency of our present civilization, seldom realized or studied—the 'quantitative approach'. The idea that you are doing well by producing a lot of things, by having so many tanks brought off the production lines every day; so many Flying Fortresses flown across the Atlantic every week; such and such an enormous percentage of men conscripted into the Forces, and of women directed into industry; long hours of work; impressive figures of war money expenditure—these have been the common encouragements of Lord Beaverbrook, Mr. Lyttelton, Mr. Bevin and others. Our production study attempted to show how this heavily quantitative approach has led to a neglect of qualitative considerations. These qualitative considerations are of two main types—the quality of the materials produced, and the quality of the personnel dealing with the product. The former type lies outside the realm of sociology, but no one who has read *Hansard* on the two days of the recent Censure Debate, including Mr. Lyttelton's speech, can doubt that there has been some muddled thinking on this side. We were concerned with the latter type.

We found over and over again that the qualitative, social and psychological factors were being ignored. The underlying assumption in war industry and in the Services, all the way through, is that men and women are units of subsidiary importance to machines, yet with many mechanical attributes. The qualitative human factors, which distinguish a soldier from a rifle, a working girl from a capstan lathe, are ignored to a surprising extent. This leads to many avoidable inadequacies. To put it in its simplest form: it does not matter how many tanks you have in Libya, or even how good they are, if the people handling them are not fully tank-minded, tank-educated, and tank-determined. Lots and lots of everything will not win anything. It is the human element, both in producing and in *using* the products which will determine the outcome of the War. This elementary point has been astonishingly ignored. It is not so astonishing, however, if it is related to the growth of industry, with its economic and numerical incentives, and this, too, we have tried to trace out in "The People in Production". The statistical obsession of the social sciences has also contributed to a neglect of the real, *human* factors.

Such material is certainly topical, and as such might, I suppose, be called 'social reporting'. But even the social sciences cannot stand above the battle. With complacency, the reviewer concludes that our study shows how "countless relatively small mistakes are being made everywhere, an ordinary state of human affairs". We cannot, at present, afford to be ordinary. The "countless relatively small mistakes" are related to a central theme, which requires analysis. What a negation of sociology to dismiss it as merely an ordinary human state: what is social science about if not that? I for one am happy to be called superficial if in being so I am helping to illuminate the mentality of the present and to preserve the integrity of the future, however inadequately.

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[1] NATURE, **149**, 711 (1942).

THE review to which Mr. Harrisson objects made it abundantly clear that the report was concerned with "the quality of the personnel dealing with the product". Ten topics of the report were mentioned, all of which dealt with qualitative, social and psychological factors. The comment was made "Emerging from the survey of most of these problems is the evident need for everybody to understand more fully what other people are doing and the conditions of their work. The Fighting Services, the Supply Ministries, management, foremen and workers all need to know more about each other. Extensive reporting of the kind offered here is one means of fulfilling the need."

What Mr. Harrisson misunderstood as my complacency about the "ordinary state of human affairs" might better have been called pessimism, except that I believe it to apply to the state of enemy affairs as well as our own. To say that the small mistakes are related to a central theme is either a truism (since everything which happens in a social group is related to some vague central theme), or else it implies a dubious political or sociological dogma, as I supposed from Mr. Harrisson's remark, "*Something* is seriously wrong somewhere".

THE REVIEWER.

RESEARCH ITEMS

Lipoid Compounds in Physiological Processes

THE importance of lipoid compounds in physiological processes such as blood clotting, in which prothrombin is activated by thrombokinase, a kephalin protein complex, or in immunological reactions where lipoid 'haptens' are assumed to join up with protein in the blood to form true antigens, is being increasingly realized. The Food Investigation Board of the Department of Scientific and Industrial Research has just issued Food Investigation Report No. 52—"The Mode of Occurrence of Fatty Acid Derivatives in Living Tissues"—by J. A. Lovern, Torry Research Station (H.M. Stationery Office. Pp. 36). This deals with the types of fatty acid derivatives occurring in lipoidal extracts, with the dynamic state of lipoids in the tissues and mainly with the lipoid-protein and lipoid-carbohydrate complexes of animals and plants. The available evidence concerning these complexes is considered according to the experimental methods used—physical methods (histological, physical determinations), physiological studies (blood clotting, antigenic reactions), solvent extraction of tissues (animal tissues, vegetable tissues), experimental preparation of lipoid-containing complexes, isolation of natural lipoid complexes, lipoprotein 'gliodes'. Comment is made on methods of splitting certain lipoproteins which may have a more general application in displacing acidic prosthetic groups from protein carriers. By adding a highly basic protein such as salmine, the phosphatide is detached, forming a phosphatide-salmine complex and leaving the original protein free and undenatured. Conversely, the addition of heparin with the formation of a heparin protein complex leaves the lipoid free. There is evidence of more than one type of lipoid-protein and lipoid-carbohydrate linkage, ranging from mere adsorption to complexes to definite chemical compounds which can be split only by drastic chemical action. An example of the latter is a lipoprotein from horse serum which is completely soluble in water, contains 22·7 per cent phosphatides, 17·9 per cent cholesterol esters and 59·1 per cent of a protein having the properties of an albumin. In spite of this high lipoid content, ether only extracts mere traces of lipoids from its aqueous solutions.

Bean and Dock Aphides

UNDER the title of "A Description of *Aphis* (*Doralis*) *rumicis* L. and comparison with *Aphis* (*Doralis*) *fabæ* Scop." Margaret E. Jones contributes the results of investigations on these two species to the April issue of the *Bulletin of Entomological Research*, **33**, 1 (1942). Both species are black in colour and both occur on species of dock (Rumex), with the result that much confusion prevails regarding their identity. *Aphis rumicis*, it is pointed out, is monophagous and confined to that host plant, while *A. fabæ* is polyphagous and is the well-known 'black fly' that infests the broad bean. *A. rumicis* is non-migratory whereas *A fabæ* over-winters on other plant-hosts, namely, Euonymus and *Viburnum opulus*. The sexuales individuals in the two species are very distinct, the males of *rumicis* being apterous and those of *fabæ* are winged. In the case of the oviparous females those of *fabæ* have broad hind tibiæ plentifully endowed with sensoria, whereas the oviparous forms of *rumicis* have slender hind tibiæ bearing very few sensoria. Differences between the two species regarding the viviparous forms are also described and the paper contains a number of explanatory text-figures.

Plant Oils as Insecticides

A TECHNICAL BULLETIN, No. 801, February, 1942, has been issued by the United States Department of Agriculture (Washington, D.C.), entitled "Insecticidal Efficiency of some Oils of Plant Origin", by A. W. Cressman and Lynn H. Dawsey. Oils may be classified into three groups according to origin—plant, animal and mineral. Oils of the last type, especially petroleum oils, have found wide utility in insect control, most of the American investigations being based on this class. The trouble with these oils has been the injurious effects which may be produced on the plants to be protected. For foliage sprays, plant oils would reduce this danger. The authors compared the insecticidal efficiencies of a number of oils of plant origin with that of a refined petroleum oil. Emulsions were prepared by mixing these oils with ground bone glue in a high-speed drink mixer. Tests, for which the Bulletin must be consulted, were carried out on Mexican mealy bugs reared on potted chrysanthemum plants in the greenhouse, which were sprayed in the laboratory. Mature females and eggs of the willow scurfy scale on willow twigs and fruit-tree leaf roller eggs on apple twigs were collected in the field and brought to the laboratory for treatment. Oils experimented with were crude corn oil, crude cottonseed and pea-nut oils and their refined stages, also orange and pine oils. It is stated that "Although vegetable oils are generally higher priced than petroleum oils, they possess superior solvent action for certain organic insecticides, and may find new uses because of this property".

Insects and Azalea Flower Spot

A TECHNICAL BULLETIN, No. 798, January, 1942, entitled "Relationship of Insects to the Spread of Azalea Flower Spot", by F. F. Smith and F. Weiss, has been issued by the U.S. Department of Agriculture (Washington, D.C.). The investigations were carried out between 1934 and 1938. It was found that five species of bumble bees (Bombus spp.), two species of carpenter bees (Xylocopa spp.), *Emphoropsis floridana*, and the honey bee, *Apis mellifera*, are the most conspicuous visitors, although thrips, flies and many others come to the flower. It is concluded that, while insects are at times efficient vectors of the organism, they are not primarily responsible for the development of the disease when once it has become established in a given planting. They may, however, be concerned with its spread to nearby plantings of azaleas. Controlling the disease, rather than the insects, therefore appears to be the logical means of attacking the problem, a method which has to be attempted so often by the forester as well as the horticulturist.

Plant Diseases in Scotland

R. W. G. Dennis and C. E. Foister publish a long list of plant diseases found in Scotland (*Trans. Mycol. Soc.*, **25**, Pt. 3; June, 1942). An important feature of the paper is the demonstration that several plant parasites common in England are not abundant north of the border. Downy mildews are scarce, except those caused by *Peronospora parasitica* and *Phytophthora infestans*. Rots due to *Sclerotinia sclerotiorum* are seldom encountered; white root

rot, *Rosellinia necatrix*, has not been reported, and violet root rot, *Helicobasidium purpureum*, is rare. Such common English cereal maladies as *Puccinia triticina*, *Ophiobolus graminis* and *Septoria Tritici* are either unknown or are seldom discovered. Scotland has the doubtful distinction of having been the channel of introduction of *Puccinia mirabilissima* on *Mahonia aquifolia* to other parts of the British Isles, but there appear to be very few diseases which are widespread in Scotland and absent from England—a fact of undoubted importance in the ecology of fungi.

Bacterial Canker of the Peach

A SHORT paper by H. Wormald (*Trans. Brit. Mycol. Soc.*, **25**, Pt. 3; June, 1942) describes a bacterial canker of the peach caused by *Pseudomonas mors-prunorum*. The disease kills infected branches and discolours the cortex. Pathogenicity has been established by inoculation, but the malady is fortunately not very widespread at present.

Genetics of Mating in Euplotes

R. F. KIMBALL (*Genetics*, **27**, 269; 1942) has discovered a multiple allelomorph series which controls conjugation in *Euplotes partella*. Six lines (or types) descended from two individuals will not generally mate within themselves but will mate with each other. An allelomorph series controls each mating in such a way that individuals carrying similar genes of this series do not conjugate. Types III, IV and VI are homozygous for the three members of the multiple allelomorph series, and types I, II and V are heterozygotes. It was found that animal-free fluid from one mating type may induce matings of animals of different type. Further investigation shows that fluid from a heterozygous type induces mating in the remaining five types, but from a homozygous type induction of mating only occurs in those types which do not have an allelomorph in common. There are aberrations in the data, such as unexpected matings within a type and failure of conjugation where it is expected; but the general scheme is coherent and further work is proceeding to analyse the exceptions. It is noteworthy that the allelomorphs produced qualitatively different substances which induce mating, and that in the heterozygote the allelomorphs are independent and not conjoint in action.

Crystal Structure of Cobalt

THE X-ray photographs obtained from cobalt depend markedly upon the previous history of the particular specimens used. The same powder photograph may include face-centred-cubic and close-packed-hexagonal lines. While this two-phase state has generally been ascribed to the presence of impurities, O. S. Edwards and H. Lipson have obtained similar photographs from cobalt of 99·99 per cent purity (*Proc. Roy. Soc.*, A, **180**, 268; 1942). The photographs show a remarkable mixture of sharp and diffuse lines. The sharp lines have $\frac{1}{3}$ $(h\text{-}k)$ integral or l zero. All others are more or less diffuse. An explanation of this is produced, based on the possibility of 'faults' occurring in the structure, because there are two different ways in which one close-packed layer of atoms can be fitted on to another. It is shown theoretically that if such faults are repeated at regular intervals the reflexions with $\frac{1}{3}$ $(h\text{-}k)$ integral are not affected, but the positions and intensities of the other lines are modified although they remain sharp. A structure with random faults would give on powder photograph broadened reflexions except for lines with l zero. A mathematical treatment of the proposed structure is given by A. J. C. Wilson (*loc. cit.*, p. 277). The frequency of faults in the specimen used in the experiments is found to be, on the average, about one in every ten planes.

Free Radical Chain Reaction

A STUDY of the detection and inhibition of free radical chain reactions has been made by J. R. E. Smith and C. N. Hinshelwood (*Proc. Roy. Soc.*, A, **180**, 237; 1942), comparing nitric oxide and propylene as inhibitors. Inhibition curves for the thermal decomposition of diethyl ether in the presence of propylene and of propaldehyde in the presence of propylene are given. An examination of the influence of propylene and of nitric acid on the thermal decomposition of acetaldehyde forms Part IV of the series of experiments, which concludes with a comparison of a series of aldehydes.

Thermal Vibrations and X-Ray Scattering

MISS K. SARGINSON has continued her theoretical study of the effect of thermal vibrations on the scattering of X-rays (*Proc. Roy. Soc.*, A, **180**, 305; 1942). The previous work on background scattering is developed in detail. Only the acoustical branches of the elastic spectrum can produce extra spots. The properties of an extra spot near a Laue spot can be derived from the elastic constants of the crystal, and explicit formulæ for the position and shape of the spots are given for cubic crystals with diagonal lattices. The applicability of the theory to Lonsdale and Smith's 'secondary spots' needs a special investigation.

Autelectronic Emission from Single Crystal Metal Points

FROM the research laboratories of the General Electric Co. a further instalment of the work on the distribution of autelectronic emission from single crystal metal points is presented by M. Benjamin and R. O. Jenkins (*Proc. Roy. Soc.*, A, **180**, 225; 1942). The adsorption, migration and evaporation of thorium, barium and sodium deposited on tungsten and molybdenum are here dealt with. Migration occurs at relatively low temperatures, and for an optimum thermionic covering there is a unique distribution of the migrating atoms on the metal crystal. Certain crystal zones, are avoided by the migrating atoms. The atoms evaporate more readily from certain crystal zones, and the differences in temperature for complete migration and evaporation of the atoms lead to an explanation of the failure sometimes to observe migration with barium, from multicrystalline surfaces, where the difference between migration and evaporation energy is small. With thorium, where the differences are much greater, the migration is always observed. In the studies of thorium on tungsten and thoriated tungsten, it is found that the diffusion occurs through the crystal lattice along certain preferred directions. The final distribution of thorium is identical with that obtained by depositing thorium from an external source. The paper is illustrated by an extensive series of photographs with their interpretation superimposed on transparent paper. (Since the work was completed, Dr. Benjamin has been killed in a flying accident.)

THE DISCRIMINATION METHOD IN ANIMAL PSYCHOLOGY

By DR. H. HONIGMANN

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THE fact that an animal is able to discriminate between two stimuli is the foundation of a method used extensively in animal psychology. It is, however, open to various sources of error. While looking through a number of papers dealing with this method I found that some of these possible pitfalls are often not sufficiently realized.

(1) The danger of influencing the animal's choice by signs given unconsciously by the experimenter is well known. It is scarcely existent in lower vertebrates and probably absent in invertebrates. In the case of mammals and birds, however, it is still underrated. Often it is not the experimenter but the apparatus used that gives the secondary cue. Bingham[1] has told with admirable sincerity how his birds "outguessed" him in experiments on discrimination between two illuminated circles of different size, one of which had a constant diameter and the other a variable diameter. The position of both circles was constantly but irregularly changed to avoid training to position. The birds surprised the experimenter by their ability to discriminate between very slight differences in area. When they were able to discriminate between two circles of 59 and 60 mm. diameter respectively, Bingham became suspicious and made both circles equal. Even then the birds were able to discriminate between the variable and the standard circle, and it turned out that the cue was a scarcely visible streak of light caused by a minute crack of the box containing the electric bulb which illuminated the standard area.

While in many cases the experimenter becomes aware of the cue guiding the reactions of his animals, this source of error is often overlooked. The most striking results obtained in work with the so-called 'multiple-choice' method and quoted for years in all papers dealing with this problem are in all probability due to secondary cues, as I have pointed out elsewhere[2].

(2) Even in the absence of all crude secondary cues, and I have mentioned only one possibility out of very many, there is always the danger that the animals in question will discriminate between the two stimuli in a way differing completely from the experimenter's assumption. Very frequently errors are caused by the confusion of the objective stimulus with its subjective equivalent; for example, brightness, being a purely subjective concept, cannot be measured in objective physical units as intensity of radiation (=heat equivalent). Two colours, which have the same brightness for us under a certain condition of adaptation, etc., acquire a different brightness for ourselves when the objective intensity of both of them is reduced to a fraction of the previous values. This is a well-known fact, but it is often overlooked that the ratio of brightness might change in quite a different way for animals in exactly the same circumstances. Thus in many papers dealing with the 'discrimination of colours' the animals in question may have only distinguished between different intensities of light, instead of different wave-lengths.

(3) Apart from these possibilities, there is still another source of error in discrimination tests: an error in the interpretation of the motives responsible for the animals' choice. As this is a matter of primary importance, misjudgment in this respect appears especially dangerous. The simplest way to deal with this problem is to give a concrete example taken from Bierens de Haan's "Animal Psychology for Biologists"[3]. This very experienced and careful worker, by means of a typical discrimination method, trained a monkey to find food behind a door marked with a red circle. There was no food behind a second door showing a blue triangle. He gives the following description of his experiments (p. 41): "When the animal was well trained, I changed the blue triangle for a blue circle or a red triangle, leaving the red circle as it was. Had it been trained to go simply to the red circle, as I supposed it was, then there would have been no reason for the monkey to make errors now, as the red circle remained visible as before. Instead of this, the animal now made about 50 per cent errors—that is, it was quite confused. The only possible explanation of this sudden confusion, as all other circumstances remained the same, is that the animal was not trained simply to go to the red circle, but to go to the red circle in opposition to the blue triangle, so that, when this latter figure was changed, the red circle lost its meaning as a guide to the food. As soon as I showed the former combination of figures, the animal was again at home, and made no more errors."

E. S. Russell, in his "Behaviour of Animals"[4], has quoted the same passage as a typical example for a reaction "where the response was to complexes rather than to single features of the perceptual field".

I cannot agree with the interpretation that here the "complex effect" of the two stimuli is the "only possible explanation". It is quite possible that the animal had not learned to open the door with the red circle, but only to avoid the one marked with the blue triangle. The blue triangle, however, was not used again in Bierens de Haan's control tests. They were therefore incomplete, and should have been supplemented by offering the blue triangle (the negative sign) in conjunction with one of the signs not used for the training—the blue circle or the red triangle.

There is still another point. When only the blue triangle had obtained a "valence" (this valuable term has been introduced by E. S. Russell into animal psychology) for the monkey, in this case a negative valence, we should not expect the animal to be confused when this sign was absent, but just an unrestricted selection of the two doors according to chance as neither was significantly marked for the animal. If we now look back to the description of Bierens de Haan's experiments in his original paper[5] we find indeed no "confusion", which would manifest itself in hesitation or even refusal to make any choice, but just the contrary. Bierens de Haan says here (p. 730) that he found it most surprising that the monkey showed so little hesitation, when the positive sign was missing, and in most cases it made its choice at once when the screen covering the apparatus was lifted "as if nothing had been altered in the experimental conditions". This confirms my opinion that here only the negative sign had obtained a valence for the animal, and actually there was no confusion and no reason whatever for the monkey to hesitate when this sign was missing. As the two other stimuli had no valence—either positive or negative—they were selected without preference and thus the

50 per cent "errors" of the monkey are fully explained without the necessity of assuming a complex effect.

One could object to this explanation that it is improbable that a negative sign would obtain a decisive valence although there was no punishment, while there was a reward (food) in the case of the positive sign. This, however, is by no means uncommon. It is very instructive to compare these results with experiments carried out much earlier by Breed.[6] This author trained fowls to discriminate between colours, for example, black from blue. When selecting blue the birds were punished by an electric shock, while in the case of a correct choice (black) the only reward was that the birds could see or join their companions again. As the negative stimulus was here the "emphatic" one, Breed expected that the birds would react indifferently when the negative sign was replaced by a new one—and so it was, at least in the majority of the cases. Even the brightness of the colours did not matter at all as these birds reacted in the same way to white-blue as to black-blue—the response being one of "getting-away-from-the-blue-no-matter-what-the-other-colour." But this did not happen in all cases, for Breed found to his surprise in three out of eight birds that they responded "definitely and positively" to black, but not negatively to blue. These three birds were quite lost when white accompanied blue, although the training procedure had been exactly the same in both cases. "With these chicks black (+) seemed to be the guiding stimulus" (p. 69), that is, they acted only according to the positive sign although this was not the emphatic one.

Breed tried to summarize his results in a general statement. He was perhaps not quite fortunate in expressing it in the following words (p. 78): "Psychologically, it seems, negation is not affirmation". Apparently he wanted to say that if we train an animal to discriminate between two stimuli, the creation of a negative valence for one of them does not necessarily mean that the other one obtains automatically a positive valence for the subject in question—and vice versa. The importance of this fact for experimental work on discrimination is obvious.

To avoid any misunderstanding, I should mention that often a complex effect can indeed be primarily decisive in discrimination tests, for one need only recall the well-known experiments carried out by W. Köhler[7] on the "structural function" (the relative choice) present in the domestic fowl and chimpanzee. Here the response was definitely to a relation between two stimuli (for example, between two different shades of grey), but Köhler was much too careful to claim that this was the only possible way of learning. The learning effect fixed to absolute characters is in his opinion only of short duration, while the effect of the "structure of the pair" is better fixed. This difference in fixation, however, is by no means sufficiently examined and would no doubt provide material for interesting psychological work. For the time being we have therefore in every discrimination test to examine not only the effect of the pair, but also of each of its single components.

[1] Bingham, Harold C., *Behav. Monogr.*, **4**, No. 4, 1 (1922).
[2] Honigmann, H., *Biol. Rev.*, **17**, No. 4 (1942).
[3] Bierens de Haan, J. A., "Animal Psychology for Biologists" (London, 1929).
[4] Russell, E. S., "The Behaviour of Animals" (London, 1934).
[5] Bierens de Haan, J. A., *Biol. Zbl.*, **45**, 727 (1925).
[6] Breed, Frederick S., *Behav. Monogr.*, **1**, No. 2, 1 (1911).
[7] Köhler, W., *Abh. Preuss. Akad. Wiss., Phys.-Math. Kl.*, **1** (1918).

RECONSTRUCTION IN OXFORD AND LIVERPOOL

THE second part of the report of the Committee on Planning and Reconstruction of the Oxford Preservation Trust, which has recently been issued, makes a number of detailed recommendations. Turning first to the new civic centre, it is recommended that it should be located where the three roads from Headington, Iffley and Cowley converge, a sufficient area being also allocated for a proper shopping centre for the eastern half of Oxford, including a new covered market. The St. Ebbe's area should be re-planned, the greater part of the site of the Oxford Prison, including the Castle Mound, being made into a public park. In the western section a new joint railway station should replace the present inconvenient and unsightly structures. In the central section the covered market should be removed, and possibly two new markets substituted, one in Castle Street and the other in East Oxford. Gloucester Green might become a square for shops and offices, while Holywell with Merton Street should preserve its present character.

In regard to surrounding towns and villages, Kidlington should become more self-contained, with better shops and social amenities. A number of villages in the vicinity of Oxford should be protected from industrialization and objectionable building, but there are in the district country towns which might welcome the advent of new light industries. The beginning of a protective girdle of open land around Oxford already exists, but early action is necessary to protect from building development a number of farms and playing-fields on the fringe of existing suburbs, together with several stretches of hill and woodland. This will involve some purchase of land in the public interest, but much will continue in use for agriculture, including market gardening.

To relieve the congestion in the centre of the city, it is essential to complete the northern and southern by-passes at the earliest date possible after the War. The northern section of an inner circular road which has also been under consideration by the City Council, with a new bridge over the Cherwell near the southern end of Mesopotamia Walk, would also be an advantage, but the difficult questions raised by the alignment of the southern section might be left for further consideration until the effect upon traffic of the various other measures contemplated becomes apparent. Other recommendations include a greater use of Cowley Station for passenger and goods traffic, doubling the single-track line to Princes Risborough, with an alternative fast railway service to London and elsewhere; provision of numerous public walks; improvements in the confused waterway system; proper control over the design of new or restored buildings, and the preservation of old houses remaining in the area of the medieval city; and adequate amenities, including a building for a proper health centre.

The post-war reconstruction of Liverpool was the subject of an address by Alderman A. E. Shennan, which has been published by the Liverpool Council of Social Service and the Merseyside Civic Society. The extensive damage which Liverpool has suffered from the numerous air raids has given it an opportunity of re-planning which it could not otherwise have hoped to see, and in commending Alderman Shennan's bold scheme, the Lord Mayor points out

in a foreword that it provides a plan of central Liverpool which would make it a place worthy of the coming needs of post-war building on a grand scale. The broad street or avenue making a circuit from pier-head to pier-head, connecting the three railway stations and forming a ring from which traffic could easily move to the outskirts without crowding the centre as at present, would give an importance to the inner section of the City which it sadly lacks to-day. Moreover, the re-planning of the pier-head itself would give Liverpool at last a water-front of which it might be proud, and through which it would proudly welcome travellers from all parts of the globe.

The first proposal covers the dock area, whereby the Dock Road, north of its junction with King Edward Street, would virtually become a private service road on a combined dock and railway estate, extending the existing dock estate eastwards to Derby Road and Great Howard Street. These two roads would be converted into a wide artery capable of carrying all north- and south-bound through traffic along the line of the North Docks, and the Overhead Railway would be replaced by a more mobile system of passenger traffic.

A major item in the plan is an inner ring road which is regarded as the proposal which could confer the greatest benefit to the heart of Liverpool. It is a feature missing in the natural development of most towns. It would give added importance to Exchange Station, and the scope for architectural treatment which the expansion of the railway termini afford is greatly stressed by Alderman Shennan. There would be a direct connexion between Exchange Station and the Lord Street–Church Street shopping centre, while the proposals for the new civic centre, the heart of which is the tunnel entrance, provide for the reservation of the St. John's Lane frontage for civic buildings, to balance the Museum and Art Gallery, and to complete the growing of the stately beauty of St. George's Hall, while on the western side, buildings connected with the administration of the City would be sited.

The town hall, the two cathedrals and the pier-head are the subject of other planning proposals, and the scheme contemplates a general rectification of the existing street plan, control by zoning, provision of industrial sites, open spaces and linking the parks. The plan involves a long-term as well as a short-term policy.

There is no reason to doubt the ability of the people of Great Britain to seize the opportunities of re-planning which the War has given us, and these two examples of plans show a vision and vigour which are the best safeguard against the apathy and selfishness which led to London missing its opportunity of nearly three centuries ago.

ELECTRICAL PRODUCTION OF BULLET-PROOF STEEL

THE manufacture of bullet-proof steel is surveyed in an article by A. G. Arend in the *Electrician* of July 31. Formerly intended for helmets, bullet-proof steel was also made for breastplates in the closing stages of the War of 1914–18. When the latter were first proposed, a manganese-vanadium steel was employed containing some 0·90 per cent of manganese and 0·20 per cent of vanadium, and was prepared in Heroult three-phase electric furnaces. Despite the purest possible metal being produced, results were not uniform, and a manganese steel was substituted containing 12 per cent of manganese, and 1 per cent of carbon.

Little has been done in the intervening years in the way of development, although vanadium steels have found extended use in automobile production. A maximum of 0·02 per cent is allowed for both sulphur and phosphorus; the small range of the other constituents precludes the use of anything but the absolute precision of control peculiar to the electric furnace. The vanadium constituent is important, and although ranging only from 0·15 to 0·25 per cent content, it allows of a light strong steel. The last approved bullet-proof steel, prepared in 6-ton Heroult furnaces, contained 2 per cent nickel, 1 per cent manganese, 0·20 per cent vanadium, 0·20 per cent silicon, 0·02 per cent phosphorus, 0·02 per cent sulphur and 0·42 per cent carbon. The admissible error was 0·05 per cent except with sulphur and phosphorus, which could not exceed the 0·02 per cent maximum.

The furnaces were not then equipped with automatic arc regulation, and gave trouble in the initial melting of scrap. Present-day furnaces are of smaller capacity and bottom connexions are omitted in the larger sizes to avoid the formation of cracks. Water cooling of bottom connexions, so far as the hearth is concerned, is now regarded as potentially dangerous.

There is a choice of design to-day between the direct arc and arc-resistance types of furnaces, the latter being preferred when a smaller charge suffices. Troubles with the smaller electrodes for 1-ton hearths resulted in the use of two-phase furnaces with bottom connexions, the current being supplied through Scott connected transformers. In comparison with the low operating voltages used for plain carbon steels, supply is usually switched on at 110 volts: with the cold scrap used in the charge, surging can momentarily raise the current as high as 10,000 amp. Since the refining period tends to vary, the energy consumption ranges from 750 to 825 kwh. per ton.

The carbon content following de-phosphorizing should be about 0·300 per cent, with the actual phosphorus below 0·02 per cent. Tapping temperature is important and after final additions have been made to the melt, it is only allowed to remain in the ladle long enough for the slag to rise properly, whereupon it is cast into ingots of about 8 in. by 14 in. cross-section, care being taken to avoid undue strains from shrinkage by chilling. Ingots are then rolled and shaped as required, undergoing any necessary heat treatment.

During 1914–18, two test methods were available for helmets and breastplates. The former, which were of 0·035 in. sheet, were subjected to the impact at 10 ft. of a bullet fired from a 0·44 Colt revolver with a muzzle velocity of 840 ft./sec. The breastplates, of 0·175 in. thickness, were expected to withstand the impact of a copper-sheathed rifle bullet fired at 50 yd. with a muzzle velocity of 2,140 ft./sec. In the former case the metal was considered to be satisfactory if the bullet did not make a dent of more than 0·5 in. in depth and 3·5 in. in diameter. Successful production of bullet-proof steel largely depends upon systematic furnace operation, and it is imperative that all electrical connexions function with precision to permit of continuous uniform working without temporary stoppages.

MANUFACTURE OF FERTILIZER FROM URBAN WASTES

By GEORGE BRANSBY WILLIAMS

THE importance of organic fertilizer in maintaining the humus content of soils, which is essential for growing crops in a healthy condition, is now widely recognized. Many definitions of the nature and functions of humus have been given, but the most practical is that given by Mr. G. V. Jacks in a paper read before the Royal Society of Arts on February 12, 1941; he said, "Humus does many things all of which can be summed up in the statement that it makes a mass of otherwise dead rock particles a suitable habitat for living plants. It is the substance which distinguishes soil from a mere geological deposit." The luxuriant growths produced by artificial fertilizers deplete humus of its essential elements unless an adequate supply of suitable organic manure is used to restore them.

It has for a long time been generally assumed that it is impossible to feed more than a fraction of the population of Great Britain on home-grown food, and the nation has resigned itself to seeing agriculture slowly decay until in many parts of the country landowners and farmers have been more concerned with the value of the land for building than with its fertility. Actually it seems that there would be no physical difficulty in growing the greater part of the food we require in our own country. The production of home produce has been in normal times an economic question, but in war-time it has become a vital matter on which the survival of the nation may depend.

If the quantity of food produced in Great Britain is vital, then so is the supply of an adequate supply of organic fertilizer. Both house refuse, and the sludge that settles out of domestic sewage, contain considerable quantities of organic matter that can be converted into humus by simple methods in a longer or shorter period. Sir Albert Howard has estimated that there is 10,000,000 tons of refuse in the controlled tips around the cities of Great Britain, and hundreds of thousands of tons of fresh house refuse are being removed from the urban areas each year. Much of this refuse is incinerated and its organic fertilizing ingredients destroyed, and the problem of finding waste land on which to tip the remainder is yearly becoming a more difficult one. The matter in the sewage amounts to nearly another million tons per year. A portion of this is discharged into the sea, and considerable expense is incurred annually in disposing of the rest by drying, pressing, trenching or digesting.

These materials, as first produced, are not in a suitable condition for application to the land, but they can be transformed into humus by composting. The system of composting urban wastes had its early development in India. Mr. R. D. Anstead related in a paper read in 1932 how, in the first instance, simple waste products, such as leaves, weeds, old straw and the like, were fermented. This method proved so successful that Dr. Fowler and others turned their attention to dealing with the refuse of Indian cities in the same way. The high temperature of initial fermentation kills all fly larvæ and all weed seeds.

Ordinary sedimentation tank sludge can be used. It has also been found that cover is not essential, for the process can be carried on very successfully in the open.

The large amount of cellulose in pulverized house refuse is just what is needed by the fungi and bacteria which synthesize microbial tissue in a manure heap.

A process for converting household refuse into fertilizer by inoculating it with a bacterial culture has been evolved by the Hyganic Company and is in operation on a large scale at the Kensington Borough Works in Wood Lane, London. Here it deals with about 100 tons of refuse per day from 180,000 persons. The process is rapid in action, but as exemplified at Wood Lane is expensive.

Simple composting or mixing in heaps on a concrete floor as carried out at Maidenhead is cheaper. The process of manufacture of the fertilizer is carried on at the sewage works. About 20 tons of refuse collected from a population of about 30,000 is delivered at the works daily. The house refuse, after picking, screening, magnetic separation and pulverizing, is stacked in heaps to a depth of about 4 ft. 6 in., the top surface of the heaps being left saucer-shaped; sludge with a moisture content of about 96 per cent is pumped daily on to the heaps. After four days, the heap is turned over on the concrete floor, then left for another three days. During this period active fermentation takes place, and the temperature rises to about 160° F. The compost is then removed to a maturing heap, here it remains for not less than four months. It is most important to mature the compost; if insufficiently matured compost is added to soil the material continues to immobilize nitrogen, and this action will compete with any plant life and lead to starvation of the crop. Sufficient maturing is only a matter of sufficient time; no additional turning is required. Neglect of this precaution in England has led to quite false ideas about the value of this compost. The price obtained for the fertilizer is from 7*s*. 6*d*. to 10*s*. a ton. The demand is greater than the supply.

The humus heap which has matured for three to four months is almost completely broken down into the condition suitable for addition to the soil. A noticeable feature is the absence of weeds, and particularly of the tomato plants which are common when sludge that has been dried on drying beds is used.

Very large sums of money are spent yearly in the urban areas of England in getting rid separately of two obnoxious waste products, namely, household refuse and sewage, without in most cases getting any return for the money. By mixing them together and passing them through a series of simple processes, not only is nuisance and expense avoided, but also a fertilizer is produced which is vitally needed by agriculture and for which a price can be obtained that should more than repay the cost of its production. The Maidenhead composting works give evidence that there is no serious difficulty in preparing the fertilizer, and it may be anticipated that in future many other towns will appreciate the simplicity and feasibility of the process. In particular it is reasonable to hope that those seaside towns which now turn crude sewage into the sea, fouling the foreshore and making bathing unpleasant and even dangerous to health, will introduce settlement, combined with composting of their refuse, and at the same time make use of the fertilizing value of seaweed. At the present time the need for such a fertilizer is urgent.

CAUSE OF THE NEW HAMPSHIRE EARTHQUAKES OF 1940

L. D. LEET has made an important contribution to this topic by his initiation of a hypothesis concerning the beginnings of the New Hampshire earthquakes of December 20 and 24, 1940, in the Ossipee Mountains district ("Mechanics of Earthquakes where there is no Surface Faulting", by L. Don Leet, *Bull. Seis. Soc. America*, **32**, No. 2; April, 1942).

On the basis of the travel-time data on elastic waves from the Ossipee earthquakes, combined with the results of Griggs's experiments on rock deformation and fracture, Prof. Leet proposes the following hypothesis. A zone of radius roughly 20 km. initially unstrained and spherical, extending upward into the crustal layers to near the base of the granitic layer, was progressively distorted by a horizontal shear couple. When the strain reached a critical value for the material, fracture occurred near the original sphere's equator and was the source of the largest shear waves. Distortion by pure shear transformed the original sphere into an ellipsoid, which terminated short of the earth's surface, where fracture had to grade into folding and die out. At the upper terminus of the resultant ellipsoid's major axis, this process would produce a concentrated compressive force on the base of the granitic layer, which started the longitudinal waves. This implies simultaneous mass movement of translation of the upper half of the original sphere. The resultant compressive stresses developed in the granitic layer kicked back four days later and produced the second earthquake. The aftershocks died quickly, in part because of rapid healing of the fractures and in part because the region was brought practically to equilibrium by the second shock, since relief came in zones of flow which, unlike surface faults, have few, if any, irregularities to produce temporary frictional hang-ups as movement progresses. If this is true, the probability is that the Ossipee structure does not extend below the base of the granitic layer, for otherwise a mass movement of the plug, which is an important feature of the White Mountains structure, would have been expected to show up at the surface.

The evidence of recent years is definitely that regional forces are at work on new levels of activity in the north-eastern American province. No great stretch of imagination is required to detect an alignment of some of this activity, including the earthquakes of December 1940, along the trend of the major reservoir for the White Mountains magma series. On grounds of distribution alone, however, there does not seem to be a satisfactory basis for distinguishing between deep-seated magmatic forces in renewed activity and yield to glacial loading stresses along old planes of weakness.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

DEPUTY ENGINEER AND MANAGER of the Southport and District Water Board—The Clerk to the Southport and District Water Board, Town Hall, Southport (September 14).

FULLY QUALIFIED FOUNDRYMAN to act as SUPERINTENDENT in the College Instructional Foundry—The Registrar, Loughborough College, Loughborough.

FORTHCOMING EVENTS

Friday, September 11

PHYSICAL SOCIETY (COLOUR GROUP), at Imperial College, S.W.7, at 2.30 p.m. Mr. E. G. Savage: "The Teaching of Colour in Schools" (Lecture followed by informal discussion).

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Why Hitler? By H. Runham Brown. Pp. 20. (Enfield: War Resisters' International.) 3*d*. [68

Proceedings of the Royal Society of Edinburgh. Section A (Mathematical and Physical Sciences). Vol. 61, Part 3, No. 16: Simultaneous Linear Partial Differential Equations of the Second Order. By E. L. Ince. Pp. 195–209. (Edinburgh and London: Oliver and Boyd.) 1*s*. 3*d*. [78

Scientific Proceedings of the Royal Dublin Society. Vol. 23 (N.S.), No. 2: The Chemical Constituents of Lichens found in Ireland, *Cladonia impexa* Harm. By T. W. Breaden, Dr. J. Keane and Dr. T. J. Nolan. Pp. 5–10. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 6*d*. [178

Geological Map of the British Islands, based on the Work of the Geological Survey. Third edition. Scale of 25 Statute Miles to 1 Inch. 36 in. × 26¼ in. (Southampton: Ordnance Survey Office.) Uncoloured, 1*s*.; coloured, 2*s*.; mounted and folded in sections, 4*s*. net. [208

Other Countries

Proceedings of the United States National Museum. Vol. 92, No 3141: Scored Bone Artifacts of the Central Great Plains. By W. R. Wedel and A. T. Hill. Pp. 91–100+plates 7–13. Vol. 92, No. 3143: The Sardis (Georgia) Meteorite. By E. P. Henderson and C. Wythe Cooke. Pp. 141–150. Vol. 92, No. 3144: Rhopocrinus, a New Fossil Inadunate Crinoid Genus. By Edwin Kirk. Pp. 151–155+plates 16. (Washington, D.C.: Government Printing Office.) [317

Publications of the Allegheny Observatory of the University of Pittsburgh. Vol. 8, No. 6: The Field of Epsilon Lyrae. By Esther M. Doody and Keivin Burns. Pp. 77–90. (Pittsburgh, Pa.: University of Pittsburgh Press.) [78

U.S. Department of Agriculture. Technical Bulletin No. 823: Strains of Field Corn Resistant to the Survival of the European Corn Borer. By L. H. Patch, J. R. Holbert and R. T. Everly. Pp. 22. (Washington, D.C.: Government Printing Office.) [78

Smithsonian Institution. War Background Studies, No. 1: Origin of the Far Eastern Civilizations, a Brief Handbook. By Carl Whiting Bishop. (Publication 3681.) Pp. 53+12 plates. (Washington, D.C.: Smithsonian Institution.) [108

Indian Forest Records, New Series. Utilization, Vol. 2, No. 6: The Thermal Conductivity of Indian Timbers. Part 1: Variation of Conductivity with Density in the Air-Dry Condition at Ordinary Temperature. By D. Narayanamurti and V. Ranganathan. Pp. iii+150–167. (Delhi: Manager of Publications.) 9 annas; 10*d*. [118

Indian Central Jute Committee. Technological Research Memoir No. 4: Tests on Commercial Jute Yarns. By C. R. Nodder. Pp. ii+25. (Calcutta: Indian Central Jute Committee.) 1.4 rupees; 2*s*. 3*d*. [128

Annual Return of Statistics relating to Forest Administration in British India for the Year 1939–40. Pp. iii+31. (Delhi: Manager of Publications.) 2.14 rupees; 4*s*. 9*d*. [128

Colony of Mauritius: Department of Agriculture. Twelfth Annual Report of the Sugarcane Research Station, 1941. Pp. 31. (Port Louis: Government Printer.) 40 cents. [138

Some Remarks on Desert Sand-Storms. By F. W. Oliver. (Printed for the Desert Committee under the sanction of the Ministry of Agriculture.) Pp. 16. (Alexandria: Whitehead Morris (Egypt), Ltd.) P.T.2. [138

Report of the Botanical Survey of India for 1940–41. Pp. 188. (Delhi: Manager of Publications.) [138

Records of the Botanical Survey of India. Vol. 6, No. 10: Useful Plants of Mayurbhanj State in Orissa. By S. N. Bal. Pp. xii+119+xx. (Delhi: Manager of Publications.) 4.14 rupees; 7*s*. 9*d*. [138

Forest Bulletin No. 102 (Chemistry, New Series): A Note on the Active Principles of *Embelia robusta*, Roxb., *Myrsine semiserrata*, Wall., and *M. capitellata*, Wall. By S. Krishna and B. S. Varma. Pp. 4. (Delhi: Manager of Publications.) 3 annas; 4*d*. [138

Indian Forest Records, New Series. Entomology, Vol. 7, No. 3: On the Biology of the Noctuidæ (Lepidoptera). By R. N. Mathur. Pp. ii+74–154+1 plate. (Delhi: Manager of Publications.) 2.4 rupees; 3*s*. 9*d*. [138

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 52: Milk Records of Sahiwal Cows in Approved Dairy Farms in India. Vol. 3 (Records received during 1938–40). Compiled by the Animal Husbandry Bureau, Imperial Council of Agricultural Research. Pp. ii+50. (Delhi: Manager of Publications.) 3 rupees; 5*s*. [138

Forest Research Institute. Indian Forest Leaflet No. 18: Some Factors affecting the Quality of Charcoal for Producer Gas Plant. By S. Ramaswami. Pp. ii+6. (Dehra Dun: Forest Research Institute.) 4 annas; 6*d*. [148

Forest Bulletin No. 101 (Chemistry, New Series): Wood Flour for Dry Electric Cells. By S. V. Puntambekar and S. Krishna. Pp. ii+4. (Delhi: Manager of Publications.) 3 annas; 4*d*. [188